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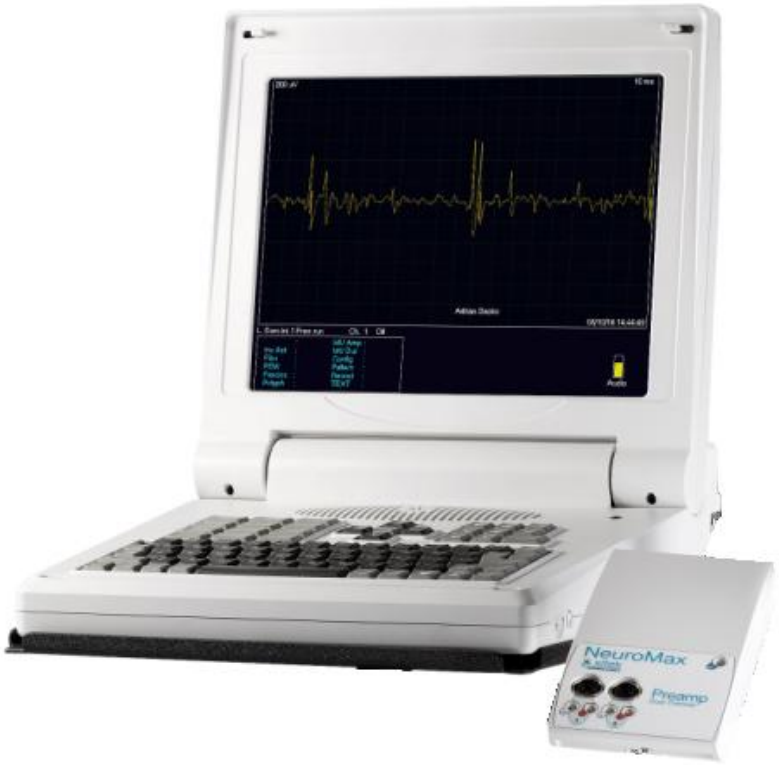
neurology

XLTEK NEUROMAX

User Manual



Publisher's Notice

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NEUROMAX SAFETY AND STANDARDS CONFORMITY

STANDARDS COMPLIANCE AND NORMATIVE REFERENCES

EMG System, model "**NeuroMax 1002**" and "**NeuroMax 1004**"; rated 120/240V, 50/60Hz, 1.4A/0.7A; detachable cord connected; Class I;Type BF applied parts.

1. Type of protection against electric shock: Class I
2. Degree of protection against electric shock: Type BF

The **NeuroMax** and its accessories have been designed to comply with the following national and international standards.

Table 1 – Safety Standard of Compliance and Normative References

CAN/CSA C22.2 No 601.1-M90	Medical Electrical Equipment part 1: General requirements for Safety adopted IEC 601-1 2ed (90)
CSA 601.1 Supplement 1:1994	Supplement No 1-94 to CAN/CSA C22.2 601.1-M90 Medical Electrical Equipment Part 1: General Requirements for Safety
CSA 601.1 Amendment 2:1998	Amendment 2 to CAN/CSA C22.2 601.1-M90 Medical Electrical Equipment Part 1: General Requirements for Safety
UL Std No 2601-1 (2nd Edition)	Medical Electrical Equipment part 1: General requirements for Safety
IEC 601-1:1988 + A1:1991 + A2:1995	Medical electrical equipment - Part 1: General requirements for basic safety and essential performance
IEC 60601-2-40 (1998-02)	Medical Electrical Equipment part 2-40: Particular requirements for the Safety of Electromyographs and Evoked Response Equipment

Table 2 – EMC Standard of Compliance and Normative References

EN 60601-1-2 :2001 (2nd Edition)	Medical Electrical Equipment, Part 1-2:General Requirements for Safety - Collateral Standard: Electromagnetic Compatibility - Requirements and Tests
IEC 61000-4-2:1995 / EN 61000-4-2:2001	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
IEC 61000-4-3:2002 / EN 61000-4-3:2006	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4:2004 / EN 61000-4-4:2004	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

IEC 61000-4-5:1995 / EN 61000-4-5:2006	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
IEC 61000-4-6:1996 / EN 61000-4-6:2007	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
IEC 61000-4-8 / EN 61000-4-8	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test
IEC 61000-4-11:2004 / EN 61000-4-11:2004	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests
IEC 61000-3-2:2005 / EN 61000-3-2:2006	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions
IEC 61000-3-3:1994 / EN 61000-3-3:1995 +A1:2001 +A2:2005	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems
CISPR 11:2004 / EN 55011:1998+A1:1999 & A2:2002	Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment - Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement
ANSI C63.4:2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
CISPR 16-1-1: 2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1:2004	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances
FCC CRF47 Part 15, Subpart B Class A	Federal Communications Commission (FCC) - Unintentional Radiators

DECLARATION OF COMPLIANCE FOR IEC 60601-1-2

Table 1 - Electromagnetic Emissions

Guidance and manufacturer's declaration – electromagnetic emissions		
The **NeuroMax 1004/1002** is intended for use in the electromagnetic environment specified below. The customer or the user of the **NeuroMax 1004/1002** should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The **NeuroMax 1004/1002** uses RF energy only for its internal function. Therefore, its RF emissions are very low and not likely to cause any interference in nearby electronic equipment
RF emissions CISPR 11	Class A	The **NeuroMax 1004/1002** is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Table 2 - Electromagnetic Immunity

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The **NeuroMax 1004/1002** is intended for use in the electromagnetic environment specified below. The customer or the user of the **NeuroMax 1004/1002** should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic Discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	Complies	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrostatic fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	Complies	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	Complies	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 sec	Complies	Mains power quality should be that of a typical commercial or hospital environment. If the user of the **NeuroMax 1004/1002** requires continued operation during power mains interruption, it is recommended that the **NeuroMax 1004/1002** be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	Complies	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital
NOTE: U_T is the AC supply voltage prior to application of the test level.			

Table 3 - Electromagnetic Immunity – for EQUIPMENT and SYSTEMS that are not LIFE-SUPPORTING

Guidance and Manufacturer's Declaration – Electromagnetic Immunity

The **NeuroMax 1004/1002** is intended for use in the electromagnetic environment specified below. The customer or the user of the **NeuroMax 1004/1002** should assure that it is used in such an environment

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the **NeuroMax 1004/1002**, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Conducted RF IEC 61000-4-6 Radiated RF IEC 61000-4-3	3 Vrms 150 kHz to 80 MHz 3 V/m 80 MHz to 2.5 GHz	Complies	**Recommended separation distance** $d = 1.2\sqrt{P}$ 150kHz to 80MHz $d = 1.2\sqrt{P}$ 80MHz to 800MHz $d = 2.3\sqrt{P}$ 800MHz to 2.5GHz where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site[a] should be less than the compliance level in each frequency[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies.
NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

a	Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the **NeuroMax 1004/1002** is used exceeds the applicable RF compliance level above, the **NeuroMax 1004/1002** should be observed to verify normal operation. If abnormal operation is observed, additional measures may be necessary, such as re-orienting or relocating the **NeuroMax 1004/1002.**
b	Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Table 4 - Recommended Separation Distances

Recommended separation distances between portable and mobile RF communications equipment and the NeuroMax 1004/1002			
The **NeuroMax 1004/1002** is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the **NeuroMax 1004/1002** can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the **NeuroMax 1004/1002** as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter (W)	**Separation distance according to frequency of transmitter (m)**		
	150 kHz to80MHz $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** $d = 1.2\sqrt{P}$	**800 MHz to 2.5 GHz** $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer. NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies. NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

DECLARATION OF COMPLIANCE FOR FCC

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Warning: Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

1. WELCOME TO THE NEUROMAX

Congratulations, you have purchased the NeuroMax from ***XLTEK***, one of the world's top manufacturers of neurodiagnostic equipment and software.

The NeuroMax offers full-featured EMG in a simple, easy to use, and affordable line of instruments. ***XLTEK*** NeuroMax is available in two and four-channel format and provides you with the highest performance and greatest reliability of any EMG instrument on the market. From simple NCS studies through to a complex quantitative EMG, the ***XLTEK*** NeuroMax is the system you can rely on.

XLTEK NeuroMax 1002 CE

Two-channel neurodiagnostic for basic and advanced NCS, EMG, and EP. Incorporates a large 12.1" XGA (1024 x 768) screen. Advanced engineering and the latest in technology allow for improved performance and speed, advanced NCS capabilities,
advanced EMG capabilities, and advanced Multi-Channel Studies.

XLTEK NeuroMax 1004 CE

Four-channel neurodiagnostic for basic and advanced NCS, EMG, and EP. Incorporates a large 12.1" XGA (1024 x 768) screen. Advanced engineering and the latest in technology allow for improved performance and speed, advanced NCS capabilities,
advanced EMG capabilities, and advanced Multi-Channel Studies.

XLTEK Headboxes and Accessories

XLTEK provides two and four-channel amplifiers, AV Stimulators, and a full range of accessories.

1.1. INTRODUCTION

XLTEK is commitment to continual product improvements and quality design to meet the needs of our clients. We thus encourage all feedback and any suggestions you have regarding any aspect of the EMG system, the manual, our line of accessories, and our support services.

1.1.1. INTENDED USE

The NeuroMax EMG is intended to be used as a clinical electromyograph to acquire, display, store and archive neurophysiological signals.

1.2. CUSTOMER SERVICE

XLTEK is committed to providing you with support so you can operate the NeuroMax with ease and confidence. If you need help, follow these steps to find a solution:

Step 1: Document the Incident

Carefully document the incident step by step. If possible, note error messages, the type of test and what you did before the problem occurred, including the sequence of keystrokes.

Step 2: Shut Down the NeuroMax

Sometimes you need to shutdown completely in order to solve a problem. Press the MAIN MENU key to return to the Main Menu. Turn the power off to the unit. Make sure all cables are connected and intact. Turn the power back on.

Step 3: Call or Email Technical Support

First, write down the serial number (located on the back of the computer). Then phone XLTEK's Customer Support at **1-800-303-0306** or contact XLTEK Technical Support at OTS@natus.com.

1.3. USING THE MANUAL

XLTEK is committed to providing you with clear instructions and unqualified support so you can operate our equipment with ease and confidence.

The manual presents step-by-step instructions which take you through the testing, customizing, and operation of the equipment and software so that our system meets your specific needs. It will guide you through the acquisition of a patient record and its review, storage, and recall. You will learn how to develop a report and to archive studies for future reference.
For your convenience, a thorough Table of Contents is provided which details the topics covered in each chapter. An Index is also available at the back of the manual.

The in-depth procedures describe the detailed operation and customization of the EMG system. The procedures, which are accompanied by detailed graphics, are designed to tailor the system to your specific circumstances. We encourage all users to explore the manual and to take advantage of everything that XLTEK has designed the EMG system to do.

When going through the procedures, we recommend that you read the whole section before starting the sequence. Please follow the instructions carefully.

TIPS

We have also placed TIPS and NOTES alongside the instructions. These will list Hot Keys, operation tips, shortcuts, and testing information.

NOTES

2. THE XLTEK NEUROMAX

The NeuroMax is designed to conduct a range of tests, including Nerve Conduction Studies (NCS), Electromyography Studies (EMG), and other tests such as Evoked Potentials, Blink Reflex, Incremental Stimulation, and Heart Rate Variability.

This chapter takes you through the Warnings and Cautions you need to observe while operating the NeuroMax and introduces you to its basic functions.

2.1. OPERATING CONDITIONS

The NeuroMax is designed for optimum performance under safe conditions. To ensure the safety of the operator and of the patient, please read the following sections carefully.

2.1.1. ENVIRONMENT PARAMETERS

Temperature Range: +10 to + 40 degrees Celsius
Relative Humidity Range: 30 % to 75 %
Atmospheric Pressure Range: 700 hPa to 1,060 hPa
Altitude: To a maximum of 4600 meters above sea level

2.1.2. TRANSPORT AND STORAGE PARAMETERS

Ambient Temperature Range: – 40 to +70 degrees Celsius
Relative Humidity Range: 10% to 100%, including condensation
Atmospheric Pressure Range: 500hPa to 1,060hPa

2.2. SPECIFICATIONS

Specification	Value
General Description	
Dimensions	4” (H) x 13” (W) x 13” (D)
Weight	11.4lbs (5.2kg)
Colour	White
Materials	Injection moulded PC ABS chassis
External Connectors	Headbox, Headphones, Printer, Footswitch (pneumatic)
Channels	4 (NeuroMaxCE 1004) 2 (NeuroMaxCE 1002)
Sampling Rate	60 kHz
Display	
Size and Type	12.1” active matrix colour LCD screen
Resolution	1024 x 768
Electrical Specifications	
Maximum Rated Input Power	92 VA
Heat Loss	92 Watts
Maximum Supply Current Tolerance	± 10% for either 50 Hz or 60 Hz transformer*
Electrical Supply Frequency Tolerance	± 10% for either 50 Hz or 60 Hz transformer*
Insulation Class and Type	Class 1, Type BF
Power Input Voltage, Frequency, and Rated Current	120 VAC, 60 Hz, 1A 230 VAC, 50 Hz, 0.4 A
Mains Connection	Protectively grounded detachable power supply cord
CMRR	~105 dB
Noise	~2.9 nV / √Hz

Stimulator Specifications	
Maximum Simulator Voltage	~450 V
Maximum Stimulator Current	100 mA
Stimulator Current Accuracy	± 1%
Stimulator Duration Accuracy	± 1%
Voltage Accuracy on Screen	± 1%

* A power supervisor circuit shuts off power if insufficient power is present.

2.3. WARNINGS AND CAUTIONS

The following Warnings and Cautions are marked with a  and must be followed very closely to ensure the safety of both the patient and the user of the NeuroMax and the AV Stim. It is therefore important to read and observe **ALL** of the Warnings and Cautions before attempting to use the NeuroMax and the AV Stim.

If there is any malfunction or perceived malfunction of the system, please call an authorized XLTEK service representative immediately at 1-800-303-0306. All internal system checks and/or service must only be conducted by an authorized XLTEK service representative.

> **IMPORTANT**: *'SYSTEM'* REFERS TO THE NEUROMAX, AV STIM, AND ALL ACCESSORIES ATTACHED TO IT.

The NeuroMax and AV Stim carry the **ordinary** equipment classification (as per IEC 529) for the level of protection against ingress of liquids. They are not drip or splash proof.

Regarding protection against electrical shock, the NeuroMax and AV Stim are classified as **Class I** devices (as per EN 60601-1). The NeuroMax

requires a properly grounded electrical outlet. The mode of operation for both the NeuroMax and AV Stim is **continuous** operation.

2.3.1. WARNINGS

Warnings MUST be followed when using the equipment. Warnings apply to conditions which can injure the patient and/or the operator.

WARNING: Care must be taken in the delivery of any level of stimulus. If used improperly, injury may be caused to the patient. The delivery of stimulus to the patient is done through the Start/Stop key on the NeuroMax and the stimulus probe.

WARNING: The level of stimulator intensity is controlled by the Up/Down arrows on the NeuroMax and the stimulation probe and is displayed on the active test screen in mA. Close attention must be paid to the level of stimulus intensity and the duration of the impulse. This unit has enough electrical power to harm a patient if used improperly.

WARNING: This system must only be plugged into a properly grounded electrical outlet. The internal isolation transformer of the system must not be bypassed, under any circumstances.

WARNING: Hazardous voltages are exposed when the lid of the NeuroMax is removed.

WARNING: This system is not suitable for use in the presence of flammable mixtures. The system is not AP or APG rated.

WARNING: Do not turn the system on until all cable connections are made and their integrity is checked.

WARNING: The proper use of this device for its intended purpose can only be assured once all instructions have been read and understood. If there are any questions regarding the operation of this device, contact your XLTEK representative at once.

WARNING: The sale, distribution, or use of this device is restricted to by, or on order of, a licensed medical practitioner.

WARNING: The NeuroMax and the AV Stim are Type BF devices (as per EN 60601-1) regarding degree of protection against electrical shock. The BF device is an applied part isolated from other parts of the EQUIPMENT to such a degree that that no current higher than the PATIENT LEAKAGE CURRENT allowable in SINGLE FAULT CONDITION flows if an intended voltage originating from an external source is connected to the PATIENT, and thereby applied between the APPLIED PART and the ground. All of the patient connections of the NeuroMax are electrically isolated; however, these connections are not intended for direct cardiac contact.

WARNING: The NeuroMax provides sufficient electrical isolation for the patient through its own internal isolation barrier. Please ensure that a printer attached to the NeuroMax through the USB port passes an appropriate safety certification.

WARNING: Non-medical electrical equipment (printers and computers) may be attached to the NeuroMax only if those devices pass appropriate safety certifications. In the case of printers and computers they should pass IEC 950 or equivalent standard.

WARNING: Possible interference with EMG and Nerve Conduction signals may occur in certain situations (i.e. poor grounding in circuitry, close proximity to other instrumentation such as an MRI).

2.3.2. CAUTIONS

Cautions must be noted when using the equipment. Cautions apply to conditions which may damage the NeuroMax.

CAUTION: It is recommended that the stimulator probe be disinfected between patients with 70% isopropyl alcohol. This is not an appropriate method of sterilization if the stimulator is used invasively.

CAUTION: Turn off all system power and disconnect the power cord from the system and the wall before attempting to clean the unit. The NeuroMax and the AV Stim can be wiped clean with a damp cloth using non-conductive distilled water, electrically non-conductive inert surfactants, or a cold sterilizing agent. It is important to dry off the units quickly. Avoid letting liquid seep into any of the internal electronics of the system. The screen of the NeuroMax is more sensitive to liquid damage than the other components of the NeuroMax, so be careful to wipe off liquid spots immediately. Use a soft cloth on the screen. Do not use any abrasive cleaner on the system. Refer to AV Stim Manual for detailed cleaning instructions for the headphones and goggles used with the AV Stim.

CAUTION: Method of sterilization or disinfection classification: no method.

CAUTION: Inspect all cables and connections (especially the power cord) often for signs of fraying or other damage. Do not operate either the

NeuroMax or the AV Stim if you suspect damage to any of the cables or the power cord.

CAUTION: Do not leave any cables attached to the back panel of the NeuroMax / AV Stim when transporting the unit -- this may cause the back panel connections to become loose, or malfunction during operation of the unit.

CAUTION: Pay particular attention to the care of the NeuroMax screen. Do not attempt to remove the protective cover. The screen itself uses a glass panel, which may crack or break if it is dropped or bumped on a hard surface. Handle with care.

CAUTION: Do not turn on the power to the NeuroMax and/or the AV Stim immediately after bringing either unit from a cold environment to room temperature. Allow the units to assume ambient environmental temperature (one-hour warm up).

2.4. EXPLANATION OF LABELING SYMBOLS

A number of symbols appear on the various components of the NeuroMax system. Please consult the table below for their meanings and significance.

Symbol	IEC Publication	Description
	384	ATTENTION: Consult Accompanying Documents
	417-5019	Protective Earth (Ground)
	878-02-02	Type BF Equipment
	878-03-01	Dangerous Voltage
	417-5032	Alternating Current
	417-5007	Power On
	417-5008	Power Off
 0086	Medical Device Directive 93/42/EEC	CE Mark
	Not Applicable	Canadian Standards Association (indicates safety approval by)

2.5. MAIN MENU

The NeuroMax opens to the Main Menu screen and lists the five menu choices available to you.

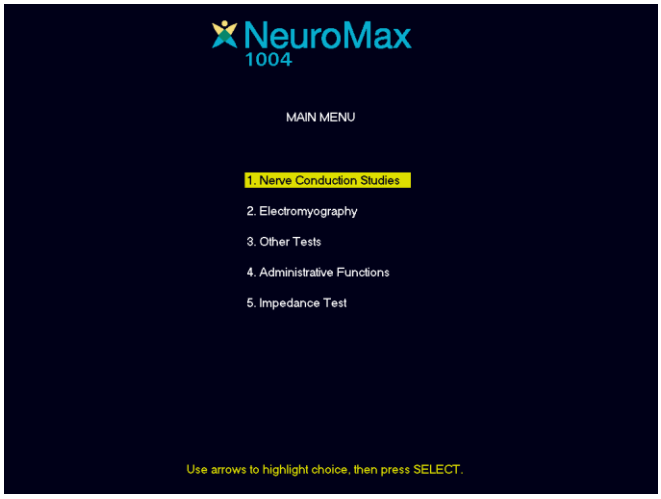


Figure 2.1: Main Menu

Choices 1-3 are the studies available on the NeuroMax:

(1) Nerve Conduction: Test motor nerve conduction, sensory nerve conduction, F-Wave, Rep Stim, and H-reflex.

(2) Electromyography: Test muscle activity with FreeRun EMG and Triggered EMG.

(3) Other Tests: Includes Evoked Potentials, Blink Reflex, Incremental Stim, and Heart Rate Variability, Multi-Channel EMG, and Multi-Channel NCS.

2.6. KEY PAD

The keypad is divided into four sections, each with its own set of functions.

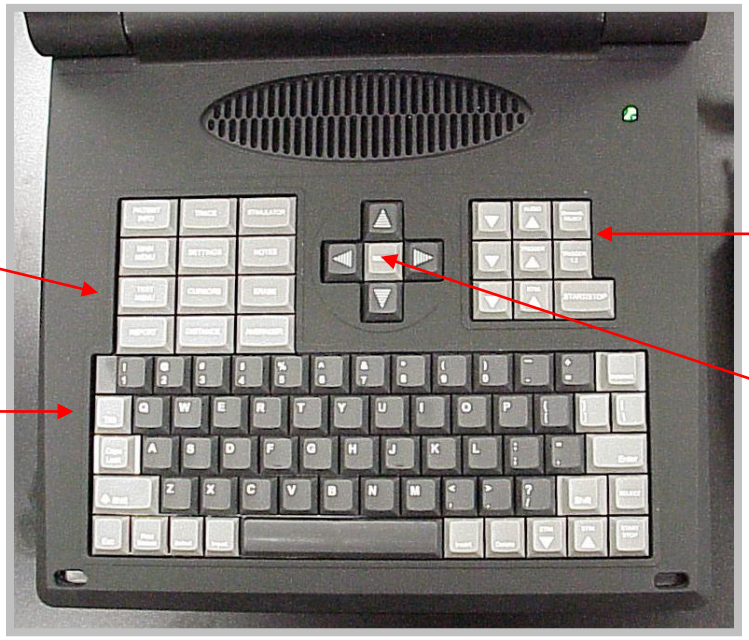


Figure 2.2: Key Pad

Alphanumeric Keyboard: Follows the familiar QWERTY pattern used on most computer keyboards.

Control Keys: Operate audio, stimulation, and trigger levels.

Figure 2.3: Control Keys

Select Keys: The **Select arrows** control the option selections and the Select key is main entry key.

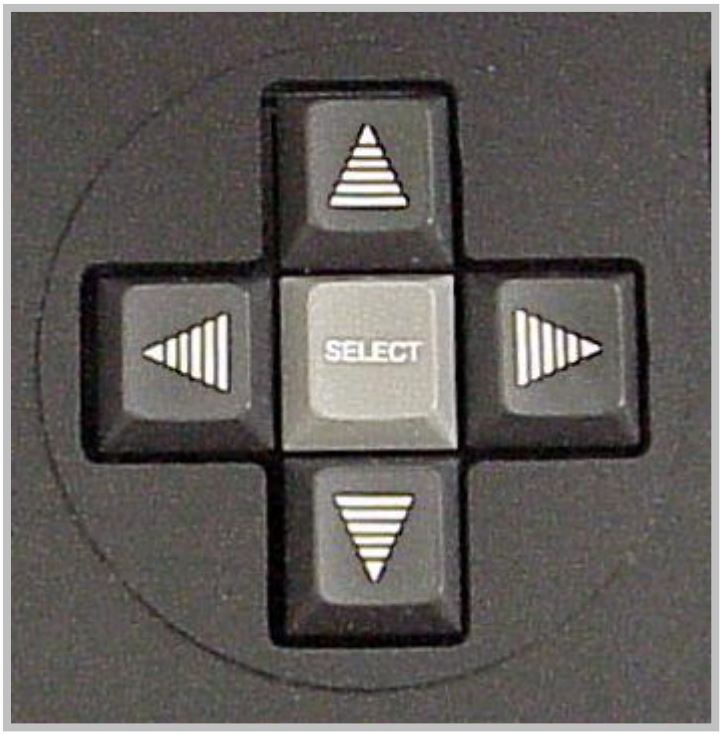


Figure 2.4: Select Keys

Function Keys: Perform and customize neurological tests.

Figure 2.5: Function Keys

The Function key operations are listed below:

TRACE FUNCTION KEY
Move, smooth, re-assign, and superimpose traces
Review stored EMG
Number of traces to raster

SETTINGS FUNCTION KEY
Low-frequency, high-frequency and notch filters
Amplifier and Display Gain, timebase and sweep delay
Trigger delay/slope

CURSORS FUNCTION KEY
Latency and amplitude cursors
Adjust position and add cursors

DISTANCE FUNCTION KEY
Segment distances in mm
Conduction velocity calculated

STIMULATOR FUNCTION KEY
Pulse duration, stim frequency, mode and max. intensity
Number of pulses/train

AV Stimulator parameters

NOTES FUNCTION KEY
Needle EMG notepad
Enter test comments
Edit site names

ERASE FUNCTION KEY
Erase single or multiple traces
Erase sets of data

AVERAGER FUNCTION KEY
Turn Averager On/Off
Acquire EP responses

SELECT FUNCTION KEY
Choose highlighted menu selection

2.7. HOT KEYS

The Hot Keys activate functions during an acquisition, providing a quick and immediate response. They will be noted in the Notes and Tips when applicable.

2.7.1. SENSORY NERVE CONDUCTION HOT KEYS

KEY	FUNCTION
Space Bar	– if in full screen mode, averaging and single acquisition mode, deletes the latest acquisition from the average
X	– post processing artifact extraction

2.7.2. ELECTROMYOGRAPHY HOT KEYS

KEY	FUNCTION
TRIGGER 1,2	– go to Triggered from FreeRun
F	– go to FreeRun from Triggered

2.7.3. EVOKED POTENTIAL HOT KEYS

KEY	FUNCTION
A	– change the Acceptance level of the signal (entered as a percentage of the A/D converter full scale value)
D	– Display only certain traces
F	– Flip to show the next or previous set of data in the data box
L	– set-up the left ear for Audio threshold test (Left = 15 dB nHL Stimulus, Right = 0 dB Noise)
R	– set-up the right ear for Audio threshold test (Left = 0 dB Noise, Right = 15 dB nHL Stimulus)
Space Bar	– show live trace

Audio tests are only valid when the AV Stimulator is attached and in Audio Stimulation mode.

2.8. CREATING A PATIENT FILE

The NeuroMax will notify you if you start a test without creating a patient file first.

An important feature of the NeuroMax is its ability to save multiple patient files and tests. This allows you to recall, edit, and print previously stored data.

The first step is to create a patient file. Once that is completed, you can save tests and generate reports.

You can access the Patient Information screen from the Main Menu and from each of the three Test menus.

1. Press the **Patient Info** PATIENT INFO key to open the Patient Information screen.

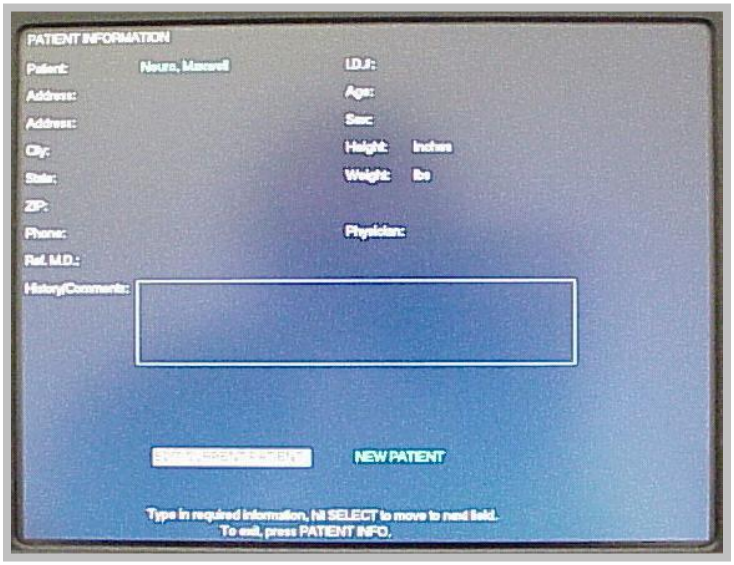


Figure 2.6: Patient Information

You can also use the Up/Down arrows, the Select key, and the keyboard keys to move the Entry field.

2. Enter the patient's information, in each of the fields. The yellow bar marks the field you are working in and the **Select** SELECT key takes you to the next field.

3. When all relevant information has been entered, press the **Patient Info** key to exit to the Main Menu.
4. Press the **Patient Info** key to open the Patient Information screen to the patient's data.
5. At the bottom of the screen, you can choose whether to edit the existing patient information or to create a new patient file.
6. To edit the current patient file, press the **Select** key.
7. To create a new patient file, press the **Right** arrow  to highlight New Patient and then press the **Select** key.

While a patient is active, the patient information can be edited and/or a new patient file can be created.

The Edit Current Patient setting is highlighted for you by the NeuroMax.

Once a test is completed, and you have returned to either the Main Menu screen or to any of the three Test Menus, that particular test will be saved and filed under the active patient name. These tests can be recalled and edited at any time from the Patient Directory.

The Patient Directory is found in the Administrative Functions. See Ch. 8 for more details.

An Active file is a patient file that is still open and new data can be added.

If the NeuroMax is turned off, the patient file is no longer active and must be recalled from the Patient Directory for review.

2.9. GENERATING TEST REPORTS

Once you have established a patient record, you can proceed to the testing stage. However, it is likely that you will need to record, store, and distribute the test data. Thus you will have to generate reports. The following sections show you how to operate the NeuroMax report function and how to design it to your specifications.

2.9.1. REPORT FUNCTIONS

The first method of reporting is to access the report functions while a patient is active.

See Section "Creating a Patient File"

You can also access the Report Functions from within any of the three test menus.

1. From the NeuroMax Main Menu screen in an active patient file, press the **Report**  key.

Figure 2.7: Patient Directory

All reporting functions can be completed by highlighting the appropriate patient and selecting the following functions.

REPORT FUNCTIONS	
View Report	You can view the report on screen before printing to verify or inspect the data
Edit Report	You can edit the tests, and the data within a test, to customize the report
Interpretation	Gives you a free text area to type a summary of the data (interpret what will be printed on the final report)
Print Report Only	Prints the report
Print Report and Waveforms	Prints the report and a condensed version of the waveforms

If a patient is not active, then the reporting functions must be accessed through the **Patient Directory** in the Administration Menu.

1. From the NeuroMax Main Menu screen, select **Administrative Menu** and then press the **Select** key 

.
2. From the Administrative Functions Menu, select **Patient Directory** and then press the **Select** key.
3. Select the function and press the Select key.

3. NERVE CONDUCTION TESTS

This chapter will deal with the operation of the NeuroMax in its Nerve Conduction Studies mode of operation.

The most important function to become familiar with is the ASSIGN function. The Assign function has been designed to streamline the process of acquiring Motor and Sensory Nerve Conductions responses. The Assign function will enable the user to peruse many acquired responses and relevant data values (i.e. latency, amplitude, etc) on the same screen at the same time, enabling them to efficiently choose the best response, without having to SAVE EACH INDIVIDUAL response during the course of the study.

When a stimulus pulse is delivered, the response will be displayed in the box at the top left-hand corner of the screen in the **Acquisition Trace Area**. Once you have acquired a satisfactory trace response you must ASSIGN it to the **Assigned Trace Area** by assigning that trace a number using the numeric keypad. Refer to figure 3.2 for a diagram of the screen trace areas.

As with other testing modes on the NeuroMax, you can create custom testing protocols and have them saved for immediate selection, without having to change all of the stimulating and recording parameters each time you do a particular test. Test Menu Parameters are covered in chapter seven (7).

3.1. MOTOR AND SENSORY NERVE CONDUCTIONS

Before you begin the Motor and Sensory Nerve Conduction Studies, set up the Patient Information screen to create an active patient file and then return to the Main Menu screen.

3.1.1. SETTING UP A NERVE CONDUCTION STUDY

1. Using the Select arrows, select **Nerve Conduction Studies** from the Main Menu and then press the **Select** key to open the Nerve Conduction Test Menu.

Figure 3.1: NCS Test Menu Screen

2. In Section 1, choose the appropriate Nerve using the Select arrows, and then press the **Select** key to continue.
3. In Section 2, choose either the Motor Nerve Conduction (MNC) study or Sensory Nerve Conduction (SNC) study using the Select arrows and then press the **Select** key to continue.

To return to the NCS Test Menu, press the Test Menu key.

4. In Section 3, choose the side you wish to test and then press the **Select** key to open the Nerve Conductions Studies (NCS) Test screen.

Figure 3.2: NCS Test Screen

All test screen graphic settings are for demonstration purposes only.

Acquired Trace Area: Shows the most recent acquisition.

Assigned Trace Area: Stores up to eight traces per NCS Test.

Live Data Box: Displays the cursor values for the acquired trace.

Data Box: Shows the cursor and calculated values for the assigned traces.

Stimulator Box: Displays the status of the electrical stimulus (stim. level, mode duration, and frequency).

The Nerve Conductions Studies (NCS) Test Screen is now active. The Acquisition Trace Area displays traces that have just been acquired. You can enlarge the Acquisition Trace Area to acquire a waveform.

1. Press the **Select** key to activate Full Screen Mode and then acquire your waveform.

2. To return to standard screen size, press the **Select** key.

3.1.2. CONDUCTING AN NCS

Make sure that all the electrode connectors are firmly in place.

1. Adjust the stimulus intensity by pressing the **Stim Up/Down** 

arrows on the Control keypad.
2. To activate the stimulus probe, press the **Start/Stop** Control 

key, the center button on the hand held stimulator to obtain the waveform, or press and release the footswitch.
3. Repeat until desired waveform is obtained.
4. Number the waveform and assign waveform to trace position using appropriate number key (1-8)  . The waveform will be placed in the Assigned Trace area.
5. Move to next stimulus site and then repeat procedure.
6. To save the test data and to exit the test, press the **Test Menu** 

key or the **Main Menu** 

key.

The stimulus intensity may also be controlled by using the **Up/Down arrow** keys on the stim probe. See System Options in Ch. 8.

The Stim levels are recorded in the Stimulator box at the bottom-right of your screen.

MNC/SNC STUDY HINTS AND FEATURES

- -- If a particular stimulus site has no response, use the **Cursors** key to move the Latency 1 cursor to the '0' position (far left) and the report will display 'NR' for the appropriate site.
- -- Pressing the **Averager** key will automatically average successive traces and the averaged trace will be displayed in the acquisition box. Once the desired response is obtained, the averaged waveform may be assigned to the appropriate position and the number of averages will return to zero to begin the next stimulus site. This feature may be used in conjunction with repetitive or train stimulus mode to quickly average more than one response.
- -- External Triggers can be connected to the NeuroMax using the BNC connector on back panel.
- -- Trigger mode and parameters can be selected by pressing the Stimulator key, or through the Defaults Test Editing page (press Default).

You can also activate the Default setting box by pressing **Backspace + C**.

3.1.3. ABOUT THE REP STIM TEST

The NeuroMax's Repetitive Stimulation program (Rep Stim) is based upon standard testing protocols. The testing protocol includes up to three testing conditions, generically named PRE, POST and RECOVERY. These denote the baseline study (PRE), the conditioned response study (POST), and a third test performed two minutes after conditioning of the response (RECOVERY). The Rep Stim program is divided into two sections: 1. SET UP procedure 2. RECORD procedure.

When Rep Stim is selected from the test menu, the screen appears as it does for any MNC or SNC test; however, the top line of the Acquisition Trace Area displays the title SET UP. The first step in the test is to attain a maximal CMAP. While you are in the set up mode, the maximal CMAP can be attained by

delivering a single shot stimulus in exactly the same manner as in an MNC test, then changing the stimulus parameters (intensity, duration, etc.), and then stimulating again until the desired CMAP is attained.

Once you have obtained the maximal CMAP, and the stimulus parameters are accurate for the Rep Stim Recording procedure, press the SELECT button. You will see the screen change slightly in appearance. The top of the screen will display RECORD. You now simply press the START/STOP key for the test to begin.

The NeuroMax will calculate and display the Amplitude (in mV) and the area (in mVms) for both the baseline response and the test response, as well as the % decrement for both the amplitude and area between the baseline and test responses.

Post-acquisition, you can change the test trace number so that a different trace is used as the test trace (press TRACE to access this function). In the test settings for the Rep Stim test, you can set the default trace numbers for both the baseline and test traces.

3.1.4. PERFORMING A REP STIM TEST

1. From the main menu, highlight Nerve Conduction Studies and then press SELECT (or hit # 1).
2. From the Nerve Conduction Studies test menu, choose the nerve you want to test, then SELECT. Now choose Rep Stim, then SELECT and, if required, choose the side you want to test, then SELECT once more.
3. The Rep Stim test screen will now appear, with the phrase SET UP at the top of the screen.

NOTE: A maximal CMAP must be attained before you can move to the RECORD screen.

4. Adjust the stimulus intensity by pressing the STIM UP/DOWN arrows.

The stimulus intensity may also be controlled by using the **Up/Down arrow** keys on the stim probe. See System Options in Ch. 8.

The stimulator levels are shown in the Stimulator box.

5. To activate the stimulus probe, press the START/STOP key, or the trigger button on the stimulator, and obtain a waveform.
6. Repeat until the desired waveform is obtained.
7. When the desired M-Wave response has been obtained, press SELECT to enter the RECORD mode.

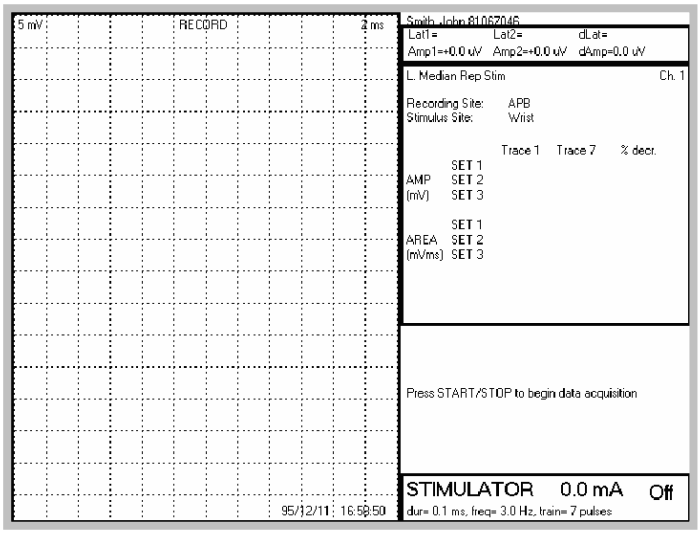


Figure 3.3: Rep Stim Test Screen – Record Mode

8. Press the START/STOP key to begin data acquisition for the Pre mode. The responses will be displayed directly in the trace data area, and the amplitudes, areas, and % decrements for the baseline and test traces will automatically be calculated and displayed in the data table.
9. If the Pre-mode data acquisition is unsatisfactory, you may erase the traces and begin again. If the response is satisfactory, continue to the next phase of the evaluation.
10. At the conclusion of the next phase of the test, press the START/STOP key to begin data acquisition for the Post mode.

11. After the prescribed recovery time period has elapsed, press the the START/STOP key to begin data acquisition for the Recovery mode

NOTE: If your test protocol requires more than three (3) sets, press 'r' on the standard keyboard to scroll to another test screen.

12. The data from each of the three test conditions are automatically entered into the data table and the final report. If you wish, you may get an individual test report, including waveforms, by pressing REPORT, and selecting SCREEN COPY.

13. To return to the test menu and do another test, press TEST MENU.

14. To return to the main menu, press MAIN MENU.

3.1.5. ABOUT THE F-WAVE TEST

The F-Wave nerve conduction protocol in the NeuroMax has functionality similar to the Repetitive Stimulation protocol previously described. Like the Rep Stim program, the F Wave study is divided into two sections: 1. SET UP procedure
2. RECORD procedure.

When F-Wave is selected from the test menu, the screen will appear as it does for any MNC or SNC test; however, the top line of the Acquisition Trace Area displays the title SET UP. The first step in the test is to determine the stimulus characteristics needed for the recording procedure. This is done by delivering a single shot stimulus in exactly the same manner as in an MNC test, then changing the stimulus parameters (intensity, duration, etc.), and then stimulating again until the desired M-Wave response is obtained. Once you have obtained the desired M-Wave response and the stimulus parameters are where they should be for the F Wave recording procedure, press the SELECT button.

You will see the screen change slightly in appearance. The top of the data area now displays RECORD, and the screen is divided into two areas. The left side of the screen has the same sensitivity factor as the F-Wave set up routine, while the right side of the screen has a separate F-Wave sensitivity. By default, the F-Wave gain will be 10% of the M-Wave gain from the set-up routine. The two gain areas are separated by a vertical red line drawn on the screen. The whole screen is continuous in timebase. Once you have pressed SELECT to enter the RECORD mode, simply press the START/STOP key to begin the train of stimuli and recording of the M- and F-Wave responses.

By default, the NeuroMax assumes that the stimulus used will be single shot stimulation for the set up and then change to train stimulation for the record mode, but these defaults can easily be changed if required. The F-Wave protocol allows for the acquisition of up to 20 responses on one screen. If you want to repeat a test, you can either erase the existing traces and then acquire new data, or you can save the existing test by going back to the test menu and re-selecting F-Wave once again.

3.1.6. PERFORMING AN F-WAVE TEST

1. From the main menu, highlight Nerve Conduction Studies and then press SELECT (or hit # 1).
2. From the Nerve Conduction Studies test menu, choose the nerve you want to test, then SELECT.
3. Choose F-wave, then SELECT.
4. If required, choose the side you want to test, then SELECT once more.
5. The F-Wave test screen will now appear, with the phrase SET UP at the top of the screen.

The stimulus intensity may also be controlled by using the **Up/Down arrow** keys on the stim probe. See System Options in Ch. 8.

The stimulator levels are shown in the Stimulator box.

NOTE: A proper M-Wave response must be obtained before you can move to the RECORD screen.

6. Adjust the stimulus intensity by pressing the STIM UP/DOWN arrows.
7. To activate the stimulus probe, press the START/STOP key, or the trigger button on the stimulator, and obtain a waveform.
8. Repeat until the desired waveform is obtained.
9. When the desired M-Wave response has been obtained, press SELECT to enter the RECORD mode.

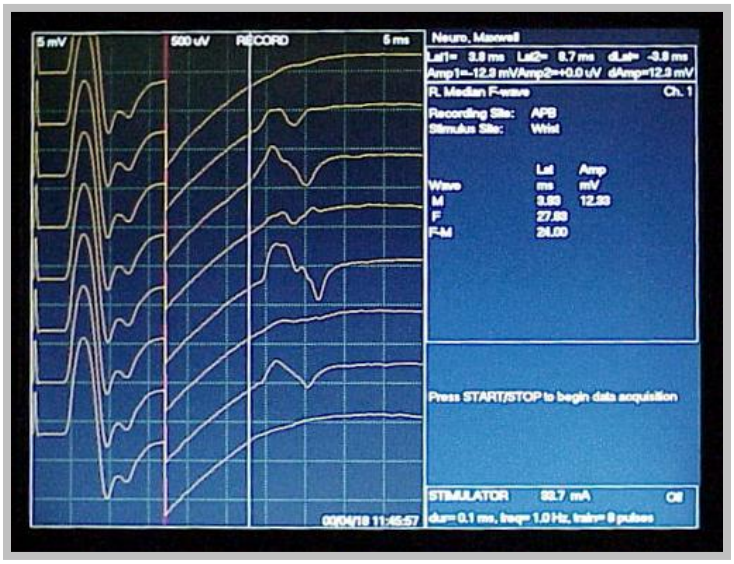


Figure 3.4: F-Wave Test Screen – Record Mode

In F-Wave testing, the acquisition area is divided into a split screen by a vertical red line. The left side has the same gain factor as the set-up routine, while the right side has an independent "F-Wave" sensitivity. The default setting of this sensitivity is 10% of the M-Wave gain.

10. Press the START/STOP key to begin data acquisition.
11. Press CURSORS to adjust the F-Wave latency cursor. To calculate F-Wave amplitude, you must first superimpose all traces (TRACE function).

NOTE: If response is absent, scroll latency cursor to '0' (far left) and report will display response as 'NR'.

12. The data acquired for the test is automatically analyzed with M- and F-Wave latencies directly imported into the data table and into the final report. If you want, you may get an individual test report, including waveforms, by pressing REPORT, and selecting SCREEN COPY.

13. To return to the test menu and do another test, press TEST MENU.

14. To return to the main menu, press MAN MENU.

F-WAVE AND REP STIM TESTS HINTS AND FEATURES

- --There are three modes in which potentials can be recorded with the differences between the modes lying in the number of times and frequency at which the patient is stimulated.
  - i. **Single Mode**: a single stimulus applied to a patient each time the S**tart/Stop** Control key is pressed. This has the advantage of allowing random time intervals between successive stimuli. The Inter-Stimulus Interval is controlled by the user.
  - ii. **Repetitive Mode**: set for an unlimited number of stimuli. The times between stimuli at a given frequency are pre-set and the mode is started and stopped using the **Start/Stop** Control key.
  - iii. **Train Mode**: the stimulator will automatically turn off after the set number of stimuli have been delivered.
- If a particular stimulus site has no response, use the **Cursors** key to move the Latency 1 cursor to the ‘0' position (far left) and the report will display ‘NR' for the appropriate site.
- While Rep-Stim testing, there are three sets of responses that may be obtained per test. If more sets are desired, and you do not wish to go through the set-

up procedure again, press **R** (Repeat). The current sets will be saved and you will be returned to the Rep-Stim record screen with the same set-up, ready to again acquire responses.

- Press the **Trace** key to designate a different comparison test response.

3.1.7. SETTING UP AN H-REFLEX TEST

To return to the NCS Test Menu, press the Test Menu key.

1. Using the Select arrows, select **Nerve Conduction Studies** from the Main Menu and then press the **Select** key to open the Nerve Conduction Test Menu.
2. In Section 1, choose the appropriate Nerve using the Select arrows and then press the **Select** key to continue.
3. In Section 2, choose the **H-Reflex Test** using the Select arrows and then press the **Select** key to continue.
4. In Section 3, choose the side you wish to test and then press the **Select** key to open the H-Reflex Test screen.

3.1.8. ACQUIRING H-REFLEX RESPONSES

1. To begin the train of stimuli and to acquire responses, press the **Start/Stop** Control key.
2. After each successive sweep, increase the stimulation intensity using the **Stim Up/Down** arrows on the Control keypad.
3. Once an adequate H Wave has been obtained press the **Start/Stop** Control key to stop.
4. Adjust stimulus mode by pressing the Stimulator key, or make changes to defaults by pressing the Default key on the keyboard.

The stimulus intensity may also be controlled by using the **Up/Down** arrows on the stim probe. See System Options in Ch. 8.

4. EMG TESTS

This chapter will deal with the operation of the NeuroMax in its EMG (Electromyography) Studies mode of operation. The NeuroMax has many views of the data on screen to view single traces, multiple traces in a raster, single traces with multiple triggered sweeps captured, compressed EMG data in the real-time window. The NeuroMax incorporates two triggers that may be adjusted independently. The first trigger is amplitude/slope. The second trigger acts as a discriminator that allows you to look at smaller potentials

The NeuroMax will store the latest ten seconds of an EMG study. You can choose to review it as a compressed EMG or as a real-time display, with a sweep of 5 ms per division. The memory buffer will automatically be cleared after each new test muscle or with a new needle insertion point.

4.1. SETTING UP THE EMG TEST MENU

Before you begin Electromyography Studies, create an active patient to set up the patient information screen and then return to the Main Menu screen.

The NeuroMax is set to run two EMG test formats: Free Run and Triggered. Sections 4.2 and 4.3 show you how to perform an EMG acquisition and which test to choose.

4.1.1. SETTING UP AN EMG

To return to the Test Menu, press the **Test Menu** key.

1. Using the Select arrows, select **Electromyography** from the Main Menu and then press the **Select** key to open the Electromyography Test Menu.

2. In Section 1, choose the appropriate Muscle or Suite using the Select arrows and then press the **Select** key to continue.
3. In Section 2, choose either the Free Run Test or the Triggered Test using the Select arrows and then press the **Select** key to continue.
4. In Section 3, choose the side you wish to test and then press the **Select** key to open the Free Run test screen.

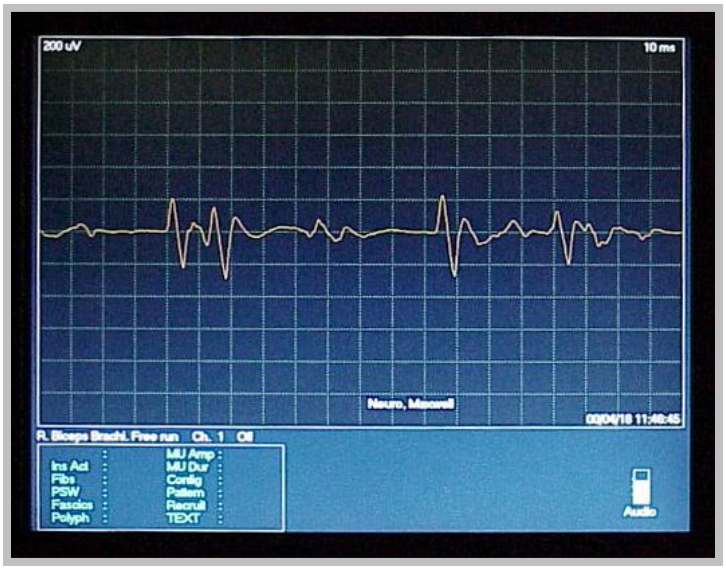


Figure 4.1: Free Run Acquisition

4.1.2. ACQUIRING AN EMG

Adjust the Audio keys before you begin to avoid excessive volume levels.

1. To start the acquisition, press the **Start/Stop** Control key.
2. To choose different gains, use the **Up/Down** arrows.
3. To end the acquisition, press the **Start/Stop** Control key.
4. To classify the results or enter comments, press the **Notes** key.

When you select TEXT entry, press the **Select** key to record a text note. Maximum 120 characters.

5. Use the Select arrows to change the fields and values in the Notes Box and then press the **Select** key to record entry.
6. Press the **Test Menu** key to select new muscles to test.
7. Repeat Steps 1-5 until you have completed test requirements.
8. To review the acquisition, see section 4.3 or press the **Main Menu** key to exit the test.

Press the Settings key to review your Acquisition settings.

4.2. FREE RUN EMG FEATURES

4.2.1. REVIEWING FREE RUN EMG

You can review the most recent acquisition you have just completed, monitor an audio portion of the test, and save waveforms.

1. After completing the Notes, press the **Trace** key to open the option box at the bottom of the screen.
2. Review is selected as the value, so press the **Select** key to review the acquisition.
3. Press the **Left/Right** arrows to move the window box forward or backward.
4. Audio Replay is highlighted. Press the **Select** key to play the last 10 seconds of audio.
5. Use the **Up/Down** arrows to select any of the other options, including the option to save the current sweep.

4.2.2. ANALYZING TURNS AND AMPLITUDE

Operating instructions are listed at the bottom of the screen.

You can analyze Turns and Amplitude while you are acquiring real-time EMG data or after it has been acquired.

1. Press the **Select** key to perform a Turns and Amplitude analysis.
2. Press the **Left/Right** arrows to move the Analysis Window.
3. Press the **Trace** key to display a Power Spectrum analysis on the screen.

4.3. TRIGGERED EMG FEATURES

When setting up the EMG test (see Section 4.1), choose Triggered Test. The Triggered EMG program uses one or two triggers to discriminate and capture various motor unit potentials. The first trigger is an amplitude/slope trigger and each EMG sweep which crosses the trigger will be copied to the "raster area." The second trigger is an "exclusion" trigger.

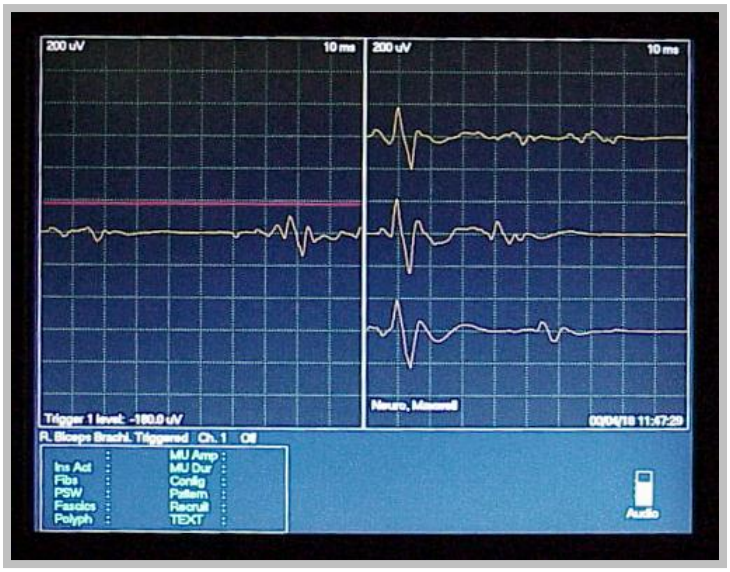


Figure 4.2: Triggered EMG

4.3.1. ACTIVATING TRIGGERS

The NeuroMax is automatically set to Trigger 1. The active trigger levels are shown at the bottom of the left screen. See Figure 4.2.

1. To adjust trigger amplitude levels, press the **Trigger Up/Down** Control arrows.
2. To activate Trigger 2, press the **Trigger 1,2** Control key.
3. To adjust Trigger 2 amplitude levels, press the **Trigger Up/Down** Control arrows.

When the Trigger Slope is negative, Trigger 2 (the exclusion trigger) negative value is greater (higher on the screen) than Trigger 1. When trigger slope is positive, Trigger 2 positive value is greater (lower on the screen) than Trigger1.

4.3.2. SAVING A TEST

1. When a number of rastered traces are on the screen, press the **Select** key to save the test.
2. To adjust the number of waveforms to raster, press the **Trace** key.
3. To adjust the cursors in the selected and the averaged waves, press the **Cursors** key.

You can save either the highlighted or averaged waveform (average of all the rastered waveforms).

4.3.3. ANALYZING AND REVIEWING MOTOR UNITS

See chapter on Test Recall Procedures.

1. Recall the test file from Patient Directory
2. Use **Left/Right** arrows to highlight (red) box containing the motor unit to be edited.
3. Press the **Cursors** key and then use the **Left/Right** arrows to move the highlighted (green) cursor.
4. Press the **Up/Down** arrows to highlight the next cursor.
5. Press the **Cursors** key to exit the editing cursor mode.

The Up/Down arrows select which of the waveforms to highlight.

5. OTHER TESTS

The NeuroMax conducts several other tests, including Evoked Potentials, Blink Reflex, Incremental Stim, Heart Rate variability, and P 300.

5.1. OTHER TESTS

Before you select any of the Other Tests, you need to set up the patient information screen to create an active patient file and then return to the Main Menu screen.

5.1.1. SETTING UP EVOKED POTENTIALS (EP)

To return to the Other Tests Menu, press the Test Menu key.

1. Using the Select arrows, select **Other Tests** from the Main Menu and then press the **Select** key to open the Other Tests Menu.
2. In Section 1, choose the appropriate test using the Select arrows and then press the **Select** key to continue.
3. In Section 2, choose **EP** (Evoked Potentials) using the Select arrows and then press the **Select** key to continue.
4. In Section 3, choose the side you wish to test and then press the **Select** key to open the EP Test screen.

Figure 5.1: EP Test

5.1.2. CONDUCTING EVOKED POTENTIALS

The Evoked Potentials test screen is similar to that of the Nerve Conductions. The gains (for all channels) and timebase are shown on the top of the acquisition box and the cursor, data, and stimulator boxes are located to the right of the screen.

1. Press the **Start/Stop** Control key to begin stimulating.
2. Press the **Averager** key to begin acquiring data.
3. Once a sufficient number of averages has been obtained, press the **Averager** key to begin acquiring the next set of traces.
4. Once acquisition of signals is completed, press the **Start/Stop** Control key to end the stimulation.
5. Press the **Cursor** key to mark signals.
6. Press the **Test Menu** key to exit and set up new test or press the **Main Menu** key to exit the test.

You can complete four sweep sets of averages.

Use Select arrows to move cursor and to select new cursors. See instructions bottom-right screen.

External Triggers are connected to the NeuroMax via the BNC connector on back panel. Trigger mode and parameters are selected by pressing the Settings key or through Defaults Test Editing page (press Default or the C key).

EVOKED POTENTIALS HINTS AND FEATURES

- There are two different gains available.
  i. **Amplifier Gain**: the actual input gain of the amplifiers. This gain influences the rejection level of the signal.
  ii. **Display Gain (sensitivity)**: magnifies the signal to better fit the screen. This second gain or sensitivity does not affect the amplification of the signal; it is simply for display purposes.
- If the amplifier gain is set too high, there is a chance that the amplifier will blocked or saturated. Thus, since Evoked Potentials are very small magnitude signals, you may wish to reject more signals than the set 99% of the amplifier limit. Using **A** (Acceptance Level), the user can choose the specific threshold for acceptance/rejection.
- Choosing Sides
  i. **Left, Right**, or **No Side**: The EP cursor placement is allocated by "sweeps." That is, each collection of sweeps is considered a "set" and cursors are placed accordingly. This option allows for 4

different sets of up to 4 traces each.

ii. **Bilateral**: Sets are defined by channel, not by sweep. The first sweep of channel 1 and the second sweep of channel 1 are considered a set and the data table is filled according to this new set definition. The bilateral selection (first two sweeps one side and final two sweeps the other) allows for up to eight sets of two traces each.

- There are ten customizable latency cursors, two amplitude, six inter-peak-interval, distance, and conduction velocity calculations are also available.
- Traces may be moved during acquisition by pressing the **Trace** key, entering the trace number, and using the Up/ Down arrows to adjust the trace.
- A single latency cursor is available to you while the traces are acquiring. Press the **Cursors** key and then use the Left/Right arrows.

5.1.3. SEP TESTS

1. Set stimulator rate between 3.1 and 7.9 Hz, but not a multiple of 60 Hz, with duration of 0.2 -- 0.3 msec.
2. Place stimulator electrode over the nerve with cathode (negative, black) proximal and cathode (positive, red) distal.
3. To set stimulus Intensity, press the **Start/Stop** Control key and use the stimulus controls to increase the current level to approximately 3 times that at which the patient first felt the shocks. Make sure that the correct muscles are visibly twitching.
4. Press the **Averager** key to begin acquiring data.

Lower stimulus durations are better tolerated but will preferentially excite motor neurons over sensory neurons.

5. When a sufficient number of averages have been obtained, press the **Averager** key to acquire the next set of traces.
6. Once acquisition of signals is complete, press the **Start/Stop** Control key to end stimulation.
7. Press the **Trace** key and then use the **Move/Superimpose** features to overlay waveforms.
8. Press the **Cursors** key to mark signals.
9. To calculate a conduction velocity, press the **Distance** key.
10. To exit the test, press the **Test Menu** key or the **Main Menu** key.

Use the Select key to toggle through each trace in succession. The Left/Right arrows move the red vertical cursor across screen. The Up/Down arrows toggle between the two/four channel sets.

5.1.4. SUGGESTED SEP PROTOCOLS

The tables below give you the suggested SEP protocols and the protocols for specific location acquisitions.

SUGGESTED SEP PROTOCOLS		
LFF: 20 Hz	**Gain:** 20uV/div	**Avgs:** 500
HFF: 2 kHz	**Sweep:** 5ms/div	**Stim Rate:** 5.3 Hz

NOTE: SEE CHAPTER 6 FOR THE AV STIM 1000 EP OPERATIONS AND PROCEDURES.

5.1.4.1. **MEDIAN *C7 TO T1* / ULNAR *C8 TO T1* *NERVES***

Channel 1	C3’/4' (-)	VS	Erb's contra (+)
Channel 2	Erb's ipsi (-)	VS	Erb's contra (+)

Channel 1	C3'/4' (-)	VS	Fz (+)
Channel 2	Cv5 (-)	VS	Fz (+)

Channel 1	C3'/C4' (-)	VS	Fz (+)
Channel 2	Cv7 (-)	VS	Fz (+)
Channel 3	Erb's (-)	VS	Fz (+)
Channel 4	Elbow (-)	VS	Fz (+)

SUGGESTED SEP PROTOCOLS		
LFF: 20 Hz	**Gain:** 20uV/div	**Avgs:** 500
HFF: 2 kHz	**Sweep:** 5ms/div	**Stim Rate:** 5.3 Hz

5.1.4.2. *POSTERIOR TIBIAL NERVE L5 S1 S2*

Channel 1	Cz (-)	VS	Fz (+)
Channel 2	Pop fos ipsi (-)	VS	Pop fos contra (+)

5.1.4.3. *COMMON PERONEAL NERVE S1 S2*

Channel 1	Cz (-)	VS	Fz (+)
Channel 2	Cv5 (-)	VS	L3 (+)

5.1.5. DERMATOMAL SEPS

Wrapping the stimulated digits in gauze prevents stimulation spread to adjacent dermatomes.

DERMATOMAL SEP PROTOCOLS	
LFF: 5 Hz	**Stim Rate:** 3.3 Hz
HFF: 500 Hz	**Stim Duration:** 0.2 ms

5.1.5.1. **MEDIAN *DERMATOMAL***

C6: Stimulate using ring electrodes places over 1st or 2nd digit, cathode proximal, anode 2cm distal.			
Channel 1	Cz (-)	VS	Fz (+)
Channel 2	Cv5 (-)	VS	L3 (+)

5.1.5.2. **ULNAR *DERMATOMAL***

C8: Stimulate using ring electrodes places over 5th digit, cathode proximal, anode 2cm distal.			
Channel 1	C3'/4' (-)	VS	Fz (+)
Channel 2	Erb's ipsi (-)	VS	Erb's contra

5.1.5.3. **POSTERIOR TIBIAL *DERMATOMAL***

L5: Stimulate medial side of the 1st metatarsal phalangeal joint with a bar electrode, anode distal.			
Channel 1	Cz (-)	VS	Fz (+)

S1: Stimulate lateral side of the 5th t metatarsal phalangeal joint with a bar electrode, anode distal.

Channel 1	Cz (-)	VS	Fz (+)

5.1.5.4. **SURAL *DERMATOMAL***

S1: Stimulate under the lateral malleolus, anode distal.			
Channel 1	Cz (-)	VS	Fz (+)

5.2. BLINK REFLEX

The Blink Reflex test as designed on the NeuroMax is an easy to use protocol for the evaluation of the R1 and R2 Compound Muscle Action Potentials recorded from the orbicularis oculi muscle in response to stimulation of either the supraorbital or infraorbital branch of the trigeminal nerve. The Blink Reflex test allows for the complete examination to be performed on one test screen, with the flexibility in setting up the default configuration to allow you to run your own specific protocol.

To return to the Other Tests Menu, press the **Test Menu** key.

5.2.1. SETTING UP A BLINK REFLEX TEST

1. Using the Select arrows, select **Other Tests** from the Main Menu and then press the **Select** key to open the Other Tests Test Menu.
2. In Section 1, choose the Facial setting using the Select arrows and then press the **Select** key to continue.
3. In Section 2, choose **Blink** using the Select arrows and then press the **Select** key to continue.
4. In Section 3, the Bilateral side is defaulted. Press the **Select** key to open the Blink Test screen.

The selections for a Blink test are limited by the nature of the test, thus the NeuroMax notifies you if the wrong nerve is selected.

5.2.2. CONDUCTING BLINK REFLEX TESTS

There are ten customizable cursors. Six inter-peak-interval calculations are also available.

1. Press the **Start/Stop** Control key to stimulate.
2. Press the **Select** key to accept waveforms and move to the other side.
3. Press the **Cursors** key to mark the signals.
4. Press the **Test Menu** key or the **Main Menu** key to exit the test.

If you wish to begin on the Right side (Left is the default), when no waves have been acquired, press the **Select** key to switch sides.

5.3. INCREMENTAL STIMULATION

The incremental stim test provides an indication of the relative sizes of the motor units in a muscle, but it can also be employed to estimate the number of the functioning motor units. The muscles which are most suitable for the technique are the EDB (extensor digitorum brevis) and the median innervated thenar muscles, but the technique has also been used routinely for the hypothenar, plantar and bicep muscles. In each stimulation, the active recording electrode is a silver chloride strip which is applied across the muscle belly at the level of the innervation zone; a similar surface electrode is positioned over, or beyond, the distal tendon and serves as a reference. The stimulating electrodes are placed over the motor nerve or, in some instances, the motor point of the muscle. It is important that the subject remain relaxed; otherwise, traces will be rejected.

5.3.1. SETTING UP INCREMENTAL STIM TESTS

1. Using the Select arrows, select **Other Tests** from the Main Menu and then press the **Select** key to open the Other Tests Test Menu.
2. In Section 1, choose the Nerve/Muscle using the Select arrows, and then press the **Select** key to continue.

To return to the Other Tests Menu, press the **Test Menu** key.

3. In Section 2, choose **Incr Stim** using the Select arrows, and then press the **Select** key to continue.
4. In Section 3, choose either the Left or the Right side, and then press the **Select** key to open the Incremental Stim screen.

5.3.2. CONDUCTING INCREMENTAL STIM TESTS

1. Press the **Start/Stop** Control key to begin the stimulation.
2. Increase the stimulation intensity until a small response is seen.
3. Press the **Select** key to save response.
4. Increase the stimulation slowly and save responses which are different from those on the screen.
5. When ten or more waveforms have been acquired, stop the repetitive stimulation by pressing the **Start/Stop** Control key.
6. Press the **M** key on the keyboard.
7. Press the **Start/Stop** Control key to deliver single stimuli.
8. Increase stimulus until response is maximal.
9. Press the **Select** key to save.

The **M** is set up to determine maximal response – gain changes to 5mV/div.

5.3.3. INCREMENTAL STIM TEST VALUES

After you have performed an Incremental Stim test, you will see information similar to the following on your screen:

1. Amplitude based estimate:24
2. Area based estimate:20
3. Estimated based on trace 14 and 15

The meanings of these values are as follows:

1. Amplitude based estimate:24 – Means that using amplitude differences, the estimate of the number of motor units is 24.
2. Area based estimate:20 – Means that using area differences, the estimate for the number of motor units is 20.
3. Estimated based on trace 14 and 15 – Means that trace 14 (presumably the smallest one) and 15 (presumably the largest one) were used for this estimate. In the case of amplitude, trace 14

should be 24 times smaller than trace 15 if the estimate is 24.

NOTE: Motor unit estimation should be used only by clinicians who already have an understanding about how it works

5.4. HEART RATE VARIABILITY (HRV)

The HRV test on the NeuroMax is designed to graph the variability in hear rate over the course of a 60 second time trial. The parameters obtained at the completion of a 60 second trial with the test are:

1. Maximum Heart rate (Max HR)
2. Minimum Heart Tate (Min HR)
3. Mean Heart Rate ()Mean HR)
4. Standard Deviation of the Heart Rate (S.D. HR)

5.4.1. SETTING UP HRV STIMULATION TESTS

1. Using the Select arrows, select **Other Tests** from the Main Menu and then press the **Select** key to open the Other Tests Menu.
2. In Section 1, choose the Nerve/Muscle using the Select arrows and then press the **Select** key to continue.
3. In Section 2, choose **HRV** using the Select arrows and then press the **Select** key to continue.
4. In Section 3, the Left side is automatically selected by the NeuroMax. Press the **Select** key to continue to the HRV test screen.

To return to the Other Tests Menu, press the **Test Menu** key.

5.4.2. CONDUCTING HRV TESTS

The Heart Rate Variability test on the NeuroMax is designed to graph the variability in heart rate over

the course of four 60-second time intervals. At the completion of each 60 second time trial, the following parameters are calculated.

HRV TEST PARAMETERS	
Maximal Heart Rate	Maximal R-R interval
Minimal Heart Rate	Minimal R-R interval
Mean Heart Rate	Mean R-R interval
Standard Deviation Heart Rate	Standard Deviation R-R interval
	HRV Ratio (Max HR / Min HR)

Press the **Erase** key to delete all or a portion of the data.

1. Set trigger to appropriate level using the **Trigger Up/Down** Control arrows.
2. Press the **Start/Stop** Control key to begin and then press it again to end the acquisition of data.
3. Press the **Select** key to save the response and then move to next graph.

Press the **Cursors** key to modify the graph area where the calculations are performed.

5.4.3. SYMPATHETIC SKIN RESPONSE

Involvement of the automatic nervous system recording of the sympathetic skin response (SSR) is one method of rapid evaluation of the autonomic nervous system. The response is also known as either the galvanic skin response or the electrodermal response. SSR reflects the voltage changes on the skin due to activation of either the palmar or plantar sweat glands in response to a variety of stimuli. In this case, electrical. The SSR is a multi segmental somatosympathetic reflex arc terminating with a final efferent pathway passing through preganglionic and postganglionic sudomotor fibers. Though intimidating to conceptualize, it is straight forward to perform. The patient must be relaxed and recumbent.
Normal recording parameter are not consistent through the literature, We suggest that you use variations of the below given parameters.
LFF 0.5 to 2.0 Hz,
HFF 500 to 5,000 Hz,
Gain 500 µV/div
Timebase 1 sec/div

Stimulate single irregular intervals with long interstimulus intervals… between one (1) to three (3) minutes to avoid habituation. Record from the side contralateral to the site of stimulation.

Hand: Reference electrode placed on the back of the hand, active electrode placed on palm. Stimulate the median nerve at a supramaximal level 0.1 msec. Cathode is proximal.

Foot: Reference electrode placed on dorsum, active electrode placed on sole. Stimulate the tibial nerve at a supramaximal level 0.1 msec. Cathode is proximal.

Latencies are measured form the stimulus artifact to the onset of the first negative OR positive peak. Amplitude is measured peak to peak. A typical recording session will consist of collecting up to ten (10) responses from each nerve and recording the mean value.

5.5. MULTI-CHANNEL EMG/IOM

Applies to the NeuroMax 1002/1004.

1. Press the **Stimulator** key and then set stim parameters, including duration, mode, maximum intensity
2. Press the **Start/Stop** Control key to begin the acquisition. Press it again to end the acquisition.
3. Press the **Space Bar** to stimulate or to begin repetitive mode.
4. Press the **Settings** key to make changes in settings.

5.6. MULTI-CHANNEL NERVE CONDUCTIONS

Choose Other Test Menu
Choose or create Nerve Test Name
Choose 4-CH NCS
Choose side
Hit DEFAULT key for Test Defaults Editing Page
Customize your settings i.e. what channel is used, what channel is on, test type, gains, timebases, sites etc.
Hit SELECT and 'S' to save settings

Example:
Median 2CH NCS

Active Ch	1	2
Channel 1	On	On
CV Segments	Segmental	Total
LFF(Hz)	5.0	30
HFF(Hz)	2.0k	2.0k
Notch Filter	Off	On
Gain (uv/div)	5k	20
Lat1	take off	take off
Lat2	neg phase	peak
Amp	bsln to peak	peak to peak
Rec Site	APB	Index
Stim Site1	Wrist	Wrist
Stim Site2	Elbow	Elbow
Stim Site3	Axilla	Axilla
Etc.		

5.7. THE P300 TEST

Please Note: This test requires NeuroMax 1004/1002, code version 2.0 (available October '99) or above and an AV Stim 1000, code version 5.0 (available October '99) or above.

5.7.1. GETTING STARTED

From the Main Menu, the P300 test can be accessed from Other Tests (Option 3). Select a Nerve or Muscle, then select P300 and a side. The test will run identically for each side.

The P300 Test screen is similar to that of Evoked Potentials. The gains (for all four channels) and

timebase are shown on the top of the acquisition box and the cursor, data and stimulator boxes are located on the right of the screen.

The stimulator box shows the two different tones to be presented to evoke the P300 response. Their frequency and weighting can be changed using the STIMULATOR hard key.

The data box contains the active cursors and once placed on a waveform, their values. These cursors can be set and labeled by editing the test's defaults. For the first set of waveforms, cursor data will be placed in Standard Set 1 or Target Set 1 (depending on whether the data was collected from a target or standard response).

The command box shows the current tone that is being presented to the patient as well as the number of traces that are either included in the averages or have been rejected. Different averages are kept for target and standard responses.

If the NeuroMax is to keep track of patient input, the command box also shows the number of times the button was pressed during a standard tone (Press on Stand.) and how many targets tones were missed by the patient (Missed Targets).

5.7.2. RUNNING THE TEST

Enter a patient name and data by pressing *PATIENT INFO* while in the Test Menu or Main Menu.

Enter the desired settings by pressing *STIMULATOR* or use *DEFAULT* to set and save these settings.

Press START/STOP to begin stimulating and *AVERAGER* to begin acquiring data – the response from the standard tone is placed above the response from the target (oddball) tone.
Once a sufficient number of averages have been obtained, press *AVERAGER* to begin acquiring next set of traces.

Once acquisition of signals is completed, press *START/STOP* to end stimulation.

Press *CURSORS* to mark signals.

Press *TEST MENU* or *MAIN MENU* to exit the test.

The patient response can be monitored using the space bar or the external foot switch. The external foot switch can be connected to the back of the NeuroMax. The type of patient response is set in the *STIMULATOR* menu under Patient Input.

5.7.3. HINTS AND FEATURES

There are two different gains available. Amplifier gain is the actual input gain of the amplifiers. This gain influences the rejection level of the signal. Secondly, Display sensitivity, is used to further scale the signal to better fit the screen. This second gain or sensitivity does not affect the amplification of the signal; it is simply for display purposes.

Traces may be moved during acquisition by pressing *TRACE*, entering the trace number and using the UP or DOWN arrow keys.

A single latency cursor is available while the traces are acquiring, by pressing CURSOR, and is moved using LEFT or RIGHT arrow keys.

Two sets of traces can be acquired, for repeatability. The response from the standard tone always appears above the response from the target tone. Separate averages for the standard and target tones are maintained. Cursors can be applied to each group of traces – any combination of 10 latencies, 2 amplitudes and 6 inter-peak-intervals up to a maximum of 14. These can be turned on or off and labeled while editing defaults.

The typical response mechanism to a target tone is a finger tap or button press. The NeuroMax can monitor the patient input from a target tone from a button press. Typically, for maximal P300 amplitude, the patient must acknowledge that they have heard a target or odd tone. The patient can either enter their response via a press of the space bar or using the foot switch.

The NeuroMax keeps track of how many times a response was entered incorrectly (i.e. the space bar was pressed during a standard tone) and how many target tones were missed. These numbers appear in the command box. If a target tone is presented and an acknowledgement is not made, the response is not included in either the standard or the target average.

The current tone being presented is displayed in the command box. The NeuroMax ensures that a standard tone is always played first and ensures that a target tone is always followed by a standard tone. The type of tone to be played is determined randomly, based on the weightings assigned to each tone in the STIMULATOR menu.

The volume of the tones cannot be changed while averaging. To ensure that the volume is appropriate, press *START/STOP* until the tones can be heard. Use the hotkey *'R'* to display the raw traces. Once satisfied, acquisition can begin by pressing *AVERAGER*.

To increase the timebase, use the right and left arrows. Because the P300 event usually occurs 300 msec after the stimulus is presented, a timebase of 50 msec is recommended. The timebase cannot be changed if the stim in ON or if there are traces on the screen. Press *'R'* to erase the raw traces, *ERASE* to erase the averaged traces and START/STOP to turn off the stimulator. The timebase is limited by the inter-stim-interval so that acquisition ends before the next tone is presented.

Some recommended settings include:
LFF: 0.5 Hz
HFF: 30 Hz
Display Gain: 5 uV/div
Timebase: 50 ms
Cursors: N1, N2, P2 and P3
Inter-Stim-Interval: 2 seconds
Standard Frequency: 1000 Hz at 80%
Target Frequency: 2000 Hz at 20%

5.7.4. EXPLANATION OF OPTIONS

STIMULATOR – Number of Stimuli: The number of different tones presented to the patient. If three tones are being presented, the response from Non-Target tones is not displayed or included in any averages.

STIMULATOR – Patient Input: Indicates if the NeuroMax will keep of patient responses. If so, the patient can acknowledge a target tone with a tap of the space bar or the press of the external foot switch.

STIMULATOR – Standard, Target and Non-Target Frequency: Use the right and left arrows to scroll between the available frequencies (250, 500, 1000, 2000, 4000 Hz). Then choose the percentage that this tone should be presented. These percentages must total to 100%.

STIMULATOR – Rise/Fall Time: The number of cycles to be used as the ramp up to the tone.

STIMULATOR – Duration: The length of the tone, not including the rise/fall time.

STIMULATOR – Inter Stimulus Interval: The time between the presentation of tones. This interval must be long enough such that the tone can be presented cleanly (without cut off) and that the entire trace can be displayed before the presentation of a new tone.

5.8. THE ERG (ELECTRORETINOGRAM) TEST

5.8.1. ABOUT THE ERG TEST

The electroretinogram (ERG) measures the mass retinal response to a stimulus of light using a corneal electrode and neutral electrodes placed on the skin around the eye. The corneal electrode is placed gently behind the lower eyelid and contacts the cornea. The patient is kept comfortable with topical anesthesia, or in infants, general anesthesia may be used. A flash of light is shown to the patient and the electrodes record the retinal potentials which develop as a response to the flash. This diagnostic procedure may be useful in distinguishing between a variety of retinal disorders such as cone dystrophy and retinitis pigmentosa.

5.8.2. CONFIGURING THE ERG PROTOCOL

The ERG protocol must be configured by the user.

1. Go to **Nerve >Conduction** from the main menu.
2. Go to a **blank field**. Press **Backspace** and **C** or the **Default** key.
3. Type **ERG** and press **Select**, as advised.
4. Select the **ERG** test, then choose **Sensory** and **Left/Right** or both and press **Select**.
5. The Screen opens.
6. Press the **Default** key and choose the settings you require. (For example, a low frequency of 1 and a high frequency of 250; a time base of 10 ms /div; and a gain of 20 uv /div.)
7. Select **External Stimulator** from this panel and **trigger out or in,** as desired.
8. Choose **Active high**, **Ground on**, **60 Hz filter on**.

NOTE: Other things, such as the intensity of the flash, are controlled on the photic stimulator you have.

The above settings will result in the recording of good ERG. You will be able to record photic, scotopic and flicker fusion with suitable selections.

5.9. THE EOG (ELECTRO-OCULOGRAM) TEST

5.9.1. ABOUT THE EOG TEST

The electro-oculogram records eye movements because of a voltage difference between the cornea and retina. As the eye moves, the vector of this electric field changes with respect to a reference electrode. At least two (2) biopotential channels are required when recording eye movements to assist in distinguishing eye movement potentials from other signal artifacts.

5.9.2. CONFIGURING THE E0G PROTOCOL

The EOG protocol can be configured in a manner similar to the ERG protocol discussed previously.

1. Go to **Nerve > Conduction** from the main menu.
2. Go to a **blank field**. Press **Backspace** and **C** or the **Default** key.
3. Type **EOG** and press **Select**, as advised.
4. Select the **EOG** test, then choose **Sensory** and **Left/Right** or both and press **Select**.
5. The Screen opens.
6. Press the **Default** key and choose a low frequency of 0.1 and high frequency of 1000; a time base of 500 ms /div; and a gain of 500 uv /div.

Pre-adapted signal is acquired from each eye, then dark-adapted, and lastly light-adapted. The Arden index is calculated by dividing amplitude of light rise signal by dark-adapted eye signal and multiplying that by 100.

6. AV STIM 1000

The AV Stim is used with Evoked Potentials and operates with both the NeuroMax 1002 and the NeuroMax 1004, and with subsequent operating systems.

6.1. AV STIM 1000 FRONT PANEL

The green power indicator lights up when AV STIM 1000 is powered on.

The red stimulus indicator blinks on when the NeuroMax powers up and flashes at the set stimulus rate.

6.2. AV STIM 1000 REAR PANEL

Audio Out

LED Goggles

Update Port

NeuroMax

Connect to NeuroMax

VGA

Audio Out: Plug in the calibrated headphones supplied with your AV STIM 1000.

Warning: Only the XLTEK headphones (part number 102610) have been approved for use with your AV Stim. Patient isolation in accordance with EN60601-1 is dependent on the approved parts.

LED Goggles: LED goggles generate difficult to reproduce visual evoked potentials due to the high intensity of the flash. We suggest filling the inside of the goggles with cotton balls and asking the patient to have their eyes closed.

CAUTION: Before using the headphones and goggles, you should inspect them for any physical damage to the casings. If there are any signs of cracking, warping, or other physical damage, DO NOT use the equipment. Notify an XLTEK Customer Service Representative immediately.

Warning: Only the XLTEK LED goggles (part number 101487) have been approved for use with your AV Stim. Patient isolation in accordance with EN60601-1 is dependent on the approved parts.

Printer: An optically isolated printer port that is available only to older NeuroMax users. When using the Windows based NeuroMax this is not supported.

NeuroMax: The connector port to which the NeuroMax is attached with the supplied cable.

VGA: Standard D-sub video monitor connector. The recommended video monitor is a hospital grade VGA or SVGA monitor.

Warning: Only equipment approved to IEC950, EN 60601-1 or a similar safety standard may be connected to the "Upgrade Port" and "VGA" ports on the AV Stim 1000. The final system must be configured to meet the requirements for safety of medical systems prescribed by EN 60601-1.

6.3. CONNECTING THE AV STIM 1000

1. To perform either an auditory or visual evoked potential, connect the AV STIM 1000 to the NeuroMax using the supplied connector cable.
2. Switch the NeuroMax **Off** and then insert the male 26-pin connector of the connector cable into the AVStim port at the rear of the NeuroMax.
3. Insert the other end, also a male 26-pin connector, into the AV STIM 1000 NeuroMax port.
4. Turn the NeuroMax **On** and check the AV STIM 1000 to confirm that the green light comes on, followed by a brief flash from the red Stimulus light.

The red Stimulus light indicates that the AV STIM is correctly configured and initialized.

6.4. WARNINGS AND CAUTIONS

The following Warnings and Cautions are marked with a ⚠ and must be followed very closely to ensure the safety of both the patient and the user of the AV Stim and the NeuroMax. It is therefore important to read and observe **ALL** of the Warnings and Cautions before attempting to use the AV Stim and the NeuroMax. If there is any malfunction or perceived malfunction of the system, please call an authorized XLTEK service representative immediately at 1-800-303-0306. An authorized XLTEK service representative must only conduct all internal system checks and/or service.

6.4.1. WARNINGS

Warnings MUST be followed when using the equipment. Warnings apply to conditions, which can injure the patient and/or the operator.

WARNING: Exposure to excessive sound can cause temporary and even permanent hearing loss.

WARNING: Long term exposure to excessive light can cause temporary and even permanent changes in visual acuity.

WARNING: Patient electrical isolation (BS EN 60601-1) is ensured when all peripherals (Headphones, Printer, Goggles, Monitor) attached to the Audio Visual Stimulator are XLTEK approved. The final system configuration must meet the requirements of EN 60601-1 for safety of medical systems.

WARNING: Use of the AV STIM 1000 is not compatible with defibrillators or electrocautery devices.

6.4.2. CAUTIONS

Cautions must be noted when using the equipment. Cautions apply to conditions which may damage the NeuroMax and other equipment.

CAUTION: If you choose to attach a VGA display other than the model supplied by XLTEK, it MUST either meet IEC 601-1 or the leakage current requirements for your jurisdiction.

CAUTION: The AV STIM 1000 provides signals to the headphones, the LED goggles, and to the video stimulator. Otherwise, signals are provided by the NeuroMax.

6.5. CALIBRATION AND MAINTENANCE

The AV STIM 1000 requires minimal maintenance. The supplied headphones are factory calibrated to the specific NeuroMax you are using. If for any reason, the headphones require replacement or re-calibration, both the headphones and the AV STIM 1000 unit must be returned to XLTEK.

Please observe the following conditions:

- For the sound level pressure reading to be valid, only XLTEK approved headphones are to be used.
- The AV STIM 1000 does not at present support NTSC video monitors.
- The visual stimulator must be calibrated by the user. This involves dedicating a monitor for the purpose of presenting the visual stimulus, collecting normal values, and then fixing the brightness, contrast and distance to the patient. Do not alter these values.
- The interior surface of the LED goggles should be inspected before and after an examination, and cleaned with a soft cloth. Remove any oil or dust from both the interior and exterior surfaces.

Periodically check to be certain that all LEDs are functioning.

6.6. SUGGESTED AEP PROTOCOLS

SUGGESTED AEP PROTOCOLS		
LFF: 150 Hz	**Gain:** 2uV/div	**Pulse Frequency:** 11.1 Hz
HFF: 2.0 kHz	**Sweep:** 1ms/div	

Channel 1	A1 (-)	VS	Cz (+)
Channel 2	A2 (-)	VS	Cz (+)

The use of a jumper cable is recommended to connect the reference leads. Also, use electrode to Fz as a ground.

6.6.1. AEP IMPEDANCE CHECK

1. Press the **I** (Impedance) key while testing to check impedance levels.
2. Press the **Select** key to return to test screen.

6.7. SUGGESTED VEP PROTOCOLS

SUGGESTED VEP PROTOCOLS		
LFF: 0.5 Hz	**Gain:** 5uV/Div	**Pulse Frequency:** 1.1 Hz
HFF: 100 kHz	**Sweep:** 25ms/div	

One Channel

Channel 1	Oz (-)	VS	Cz (+)

Two Channel

Channel 1	O1 (-)	VS	Cz (+)
Channel 2	O2 (-)	VS	Cz (+)

The use of a jumper cable is recommended to connect the reference leads. Also, use an electrode to Fz as a ground.

6.7.1. VEP IMPEDANCE CHECK

1. Press the **I** (Impedance) key while testing to check impedance levels.
2. Set impedance levels.
3. Press the **Select** key to return to test screen.

Impedances of about 5 kOhms are recommended for clear results.

6.8. ACQUIRING A FULLFIELD VEP RESPONSE

The setup for the Fullfield VEP Response is completed in the Choose Side section of the Other Tests test screen.

1. Choose the eye to test. To begin with the left eye, choose the Left side and then press the **Select** key to continue.
2. Press the **Stimulator** Control key and then set the Stimulator to Left Field Stimulus and/or Right Field Stimulus.
3. Have the test subject cover the right eye and fixate towards the center of the checkerboard field with the left eye.
4. Press the **Start/Stop** Control key and begin the acquisition.
5. Press the **Averager** key to begin averaging.
6. Once a set is completed, press the **Averager** key again to collect the next set.
7. To test the Right side, press the **Test Menu** key, select the **Right** side in the Choose Side section of the Test Screen, and then press the **Select** key to continue.
8. Cover left eye and repeat steps 2-6.

If you are doing a Bilateral test, start with the left eye and follow the steps.

In a unilateral study, 4 sets of 2 channels can be collected in this manner.

If you are doing a Bilateral test (collecting waveforms on the same menu screen), switch eyes and repeat steps 3-6.

6.9. ACQUIRING A HEMIFIELD VEP RESPONSE

The setup for the Hemifield VEP Response is completed in the Choose Side section of the Other Tests test screen.

1. In the Choose Side section, select **Bilateral** and then press the **Select** key to continue.
2. Press the **Stimulator** key and set the Stimulator to Left Field **Stimulus** and Right Field **Nothing**.

Montage for Right eye (Left covered)

Channel 1	Oz (-)	VS	Fpz (+)
Channel 2	10cm lateral to O1 (-)	VS	Fpz (+)

Use these tables to set your Montage levels.

Montage for Left eye (Right covered)

Channel 1	Oz (-)	VS	Fpz (+)
Channel 2	10cm lateral to O2 (-)	VS	Fpz (+)

3. Have subject cover the **Right** eye and fixate towards the center of the checkerboard field.
4. Press the **Start/Stop** Control key and begin acquisition.
5. Press the **Averager** key to begin averaging.
6. Once a set is completed, press the **Averager** key again to collect the next set.

To switch to the other side, cover the left eye, set the Stimulator to Right Field **Stimulus** and Left Field **Nothing**.

7. SETTING THE DEFAULTS

The setting on all of your tests can be designed to suit your particular needs. Thus whenever you activate the NeuroMax to do a particular test, your specific settings will already be chosen. This automatic setting is called a "default setting," and the NeuroMax comes to you with a full complement of default settings designed to meet the greatest variety of requirements.

7.1. TEST MENU PARAMETERS

On any given test menu you can change/add the name of a nerve (Nerve Conductions Test Menu), muscle (Electromyography Test Menu), or protocol (Other Tests Menu).

CAUTION: This will permanently change the Test Menu.

1. From the NeuroMax Main Menu screen, use the Select arrows to choose the Test Menu and then press the **Select** key to open the Test Menu.
2. Use the **Left/Right** arrows to place the yellow highlight over the position to be changed.
3. Press the **Default** key to open the Default Settings box.
4. Using the keypad, enter the name of the new nerve/ muscle/ protocol.
5. Press the **Select** key to exit.

The Default key is located at the bottom left of the keyboard.

You can also activate the Default setting box by pressing **Backspace + C**.

7.1.1. CREATING AN ELECTROMYOGRAPHY SUITE

You can set the default parameters to create a personalized EMG suite that fits your specifications.

1. From the NeuroMax Main Menu, use the Select arrows to choose **Electromyography** and then press the **Select** key.
2. Use the **Left/Right** arrows to place the yellow highlight over the Suite name you wish to edit.
3. Press the **Default** key.
4. Using the keypad, enter the name of the Suite.
5. Press the **Select** key to save the name of your Suite.
6. Use the **Left/Right** arrows to place the yellow highlight over the next muscle you wish to add to the suite and then press the **Select** key. Continue until all muscles have been added.
7. Press the **Test Menu** key twice to save and exit.

The Default key is located at the bottom left of the keyboard.

You can also activate the Default setting box by pressing **Backspace + C**.

7.2. EDITING TEST DEFAULTS

Many of the test routines and features of the NeuroMax, including test protocols and other functions, are customizable to allow automation of many routines. The NeuroMax1002/1004 is equipped with factory default settings for many tests, and these are a good general guide for many of the tests and reporting features. However, you may wish to change these settings. If the changes desired are temporary, then the changes should be made using the various keys (**Settings**, **Stimulator**). However, if you want the new settings to be automatically included each time a particular test is selected, then the defaults should be changed.

1. From the NeuroMax Main Menu screen, use the Select arrows to choose the test menu and then press the **Select** key.
2. Using the Select arrows, choose the test you wish change and then press the **Select** key twice to open the Active Test Screen.
3. Press the **Default** key.
4. Use the Select arrows to choose the settings to change and then use the keyboard to enter the new values. These values become the new default settings.
5. Press the **Select** key to open the Save and Exit dialog box.

The Default key is located at the bottom left of the keyboard.

You can also activate the Default setting box by pressing **Space Bar + C**.

Press S to save, or D to discard changes.
To restore factory defaults, press R.
To continue editing defaults, press E.

Figure 7.1: Save and Exit Dialog Box

6. Select one of the options and continue. Note that you can always return to the factory default settings that came with the NeuroMax.

8. ADMINISTRATIVE FUNCTIONS

The NeuroMax Administrative Functions are designed to help you customize the NeuroMax and to manage the information acquired by the tests.

This chapter shows you how to customize reports, store data, and transfer files.

8.1. ADMINISTRATIVE FUNCTIONS

The Administrative Functions menu allows you to customize the reports, functions, and memory of the system. Data entered on these menus makes permanent changes to the system. The following chart lists the administrative functions.

REPORT FUNCTIONS	
Patient Directory	Recall, print, and edit stored patient files
Memory Management	Delete files and erase memory
Batch Print	Print all non-printed reports
System Options	Set global options including date, time, units of measure, printer type, artifact rejection, external stimulator, and more
Edit Report Format	Edit macros, select fields included in the report, and report layout
Edit Site Name List	Edit the available default stimulation sites
Edit EMG Notepad	Edit available notes for scoring EMG
Edit Patient Info. Fields	Edit the field definitions for the Patient Info screen

8.1.1. PATIENT DIRECTORY

The patient directory may be quite extensive because the NeuroMax has the ability to store many files.

Figure 8.1: Patient Directory

It outlines which patients are saved on the system, the status of those patients (Printed, Not Printed, Transferred), the date the patients were saved and gives the user certain functions.

PATIENT DIRECTORY FUNCTIONS	
Patient Callback	Recall a patient to add to the current file or to begin a new study.
Test Directory	View list of test files, along with the date and time they were performed. Within this directory, tests can be recalled and then edited or deleted.
Print Report	Print the highlighted patient report.
View Report	View the highlighted patient report.
Delete Patient	Delete Patient and tests
Edit Patient Info.	Edit the selected patient information.

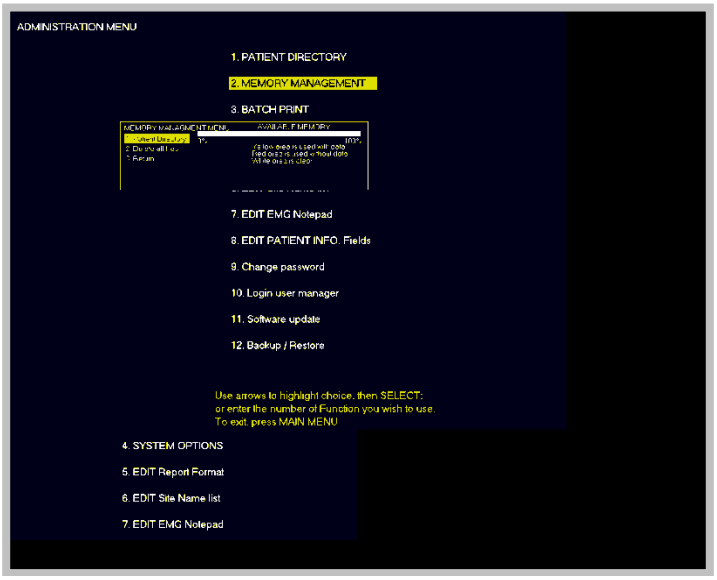
Make sure you select the patient file before activating the Function options.

Future Expansion	
Print All Test Screens	Print all performed test waveforms in condensed format.
Print Letter	Print the history and interpretation in a letter format with the referring doctor's name.
Save File to USB	Moves highlighted files to USB device. See section 8.1.2. for details.
Exit Directory	Exit to Administration Menu.

8.1.2. MEMORY MANAGEMENT

The Memory Management Option shows you the available memory and how to clear the memory to allow for more patient files. You should monitor the memory on the NeuroMax regularly and archive the reports you wish to store.

Figure 8.2: Memory Management



IMPORTANT: Deleting patient files from the NeuroMax moves the information from live file memory, which is shown as a yellow bar, to deleted file memory, which is shown as a red bar. Both types of file memory will increase to fill the total maximum amount of memory available.

To free up more memory on the NeuroMax, you must archive/backup all deleted files by: 1. Saving the files to another computer via USB or 2. By printing hard copies of the files.

Once you have backed up all the files use these steps to permanently delete the deleted files and free more memory. **TAKE NOTE THAT THE PERMANENT DELETION OF FILES PERTAINS TO ALL DELETED FILES OR NONE OF THE DELETED FILES.**

1. Start in the Main Menu.
2. Select Administrative Functions #4.
3. Select Memory Management #2.
4. Select Delete All Files #2.

8.1.3. BATCH PRINT

Batch Print collects and prints all the patient files that have not yet been printed.

8.1.4. SYSTEM OPTIONS

Using the System Options allows you to set a variety of standards for display formats and printed reports. You can also enhance the NeuroMax's performance.

Figure 8.3: System Options

8.1.5. EDIT REPORT FORMAT

You can design the report formats to fit your particular requirements. The NeuroMax provides five areas to customize.

i) **Edit Report Header**: Places name, address, and other information on all reports.
ii) **Edit Interpretation Macros**: Provides titles for automatic notes use in history and interpretation fields.
iii) **Turn on/off Report Fields**: Selects the fields to be printed in the tables of the report.
iv) **Change Report Layout**: Edits the report format to sort by time, test name, and Muscle or nerve.
v) **Return To Administration Menu**: Returns you to the main administration menu.

8.1.6. EDIT SITE NAME LIST

You can change or add the default stimulation site names by selecting an existing name and then deleting and entering a new name.

The new name cannot be more than 12 characters long.

8.1.7. EDIT EMG NOTEPAD

You can edit the standard Notes format available when acquiring EMGs to reflect your requirements.

8.1.8. EDIT PATIENT INFORMATION FIELDS

You can customize the fields you would like to appear on the patient information section of the reports.

8.1.9. CHANGING THE DATE ON STORED DATA

On pre-stored files:
1. Turn On the NeuroMax, or be certain that there is currently no selected patient.
2. From the **Main Menu**, select **Administration Functions** then **Patient Directory**

3. Choose the **Patient** Choose **0. Patient Callback** into **Current Study**
4. Choose **Main Menu** followed by **Administration Functions** followed by **SYSTEMS OPTIONS**
5. You are now going to change the date to suite your needs.
6. Choose **Edit Date** or **Edit Time** and set to the required needs.
7. Exit from this screen, go to **Main Menu** and press **Patient info.** And choose **Edit Current Patient.**
8. You must now rename the patient. I suggest that you simply add aaa to the beginning of the patient name.
9. Press **Patient Info.** When done.
10. Patient is now stored under the new date.
11. You must now press **Patient Info.** again and remove the aaa from the patient name. Press **Patient info**. To exit this screen
12. Repeat steps 4 to 6 to change the date back to the current date.
13. You are now complete.

8.2. MANAGING THE REPORTS

Once you have transferred the reports from the NeuroMax to your PC, you can view them, print them, edit them, and/or discard them. Transferring the files by cable also changes their format into Rich Text Format (RTF), which can be read by a variety of word processing programs.


You can decide how you want to manage the files, whether you want to use them or periodically delete them

8.2.1. RICH TEXT FILES (RTF)

Downloading files to a USB device will automatically create files with an RTF file extension in the default directory.


Rich Text Format (RTF) files can be imported into many different Windows applications such as **Word**.

8.3. EXTENDED WARRANTY SERVICES INFORMATION

An extended warranty can be purchased prior to or following the expiration of your ***NATUS*** original warranty. For further information, contact XLTEK's Customer Support at **1-800-303-0306** or Oakville_Customer_Service@natus.com**.**

9. APPENDIX 1: IN-SERVICE CHECKLIST

natus neurology

NeuroMax In-Service Checklist

Name/Institution: _____

Tel: _____ Fax: _____ Email: _____

Additional Contacts: Name Position

_____ _____

_____ _____

Basic Functions

Connections for NeuroMax:

- USB Printer ☐
- Headbox ☐
- Stim Probe ☐
- Accessories ☐
- USB Mass Storage ☐
- Foot Switch ☐
- AV STIM ☐
- External Trig ☐

Keyboard Layout:

- Function Hard Keys ☐
- Menu Hard Keys ☐
- Select Switch ☐
- Arrow Keys ☐
- Trigger Arrows ☐
- Stimulus Intensity ☐
- Functions: Opening a Patient File ☐
- Electrode Impedance Testing ☐
- Hot Keys ☐

Power Supply of NeuroMax:

AVStim: ☐

Nerve Conduction Functions

- Assigning Waveforms ☐
- Full-Screen Acquisition ☐
- Trace ☐
- Settings ☐
- Cursors ☐
- Distance ☐
- Stimulator ☐
- Notes ☐
- Erase ☐
- Average ☐
- Exponential Decay ("X") ☐

Creating Protocols for:

- SNC ☐
- MNC ☐
- F-Wave ☐
- Rep Stim ☐
- H-Reflex ☐

Electromyography

Basic Functions:

- Recording (Start/Stop) ☐
- Settings: (Gain/Timebase) ☐
- Audio Adjustments ☐
- Notepad ☐
- Suites ☐

Advanced Functions:

- Review ☐
- Turns and Amplitudes ☐
- Motor Unit Analysis (1,2) ☐
- Free Run to Triggered ☐ (key function)

Creating Editing:

- Defaults
- Triggered Defaults
- EMG Suites
- Muscles

Programs:

- Free Run ☐
- Triggered ☐

Administrative Functions

Patient Directory:

Search Utility ☐
Patient Callback ☐
Test Directory ☐
Print Report ☐
View Report ☐
Delete File ☐
Edit Patient Info ☐
Transfer to USB ☐
Print Test Screens ☐

Batch Print: ☐

Memory Management:

Patient Directory ☐
Delete All Files ☐
Delete All Printed files ☐

System Options:

1) Report Format
-Report Header ☐ -Report Fields ☐
-Interpretation Macros ☐ -Report Layout ☐
2) Site Name List ☐
3) EMG Notepad ☐
4) Patient Information Fields ☐

Dual Channel Tests

Functions:

EP's - Stimulating ☐
Averaging ☐
Saving Waveforms ☐
Cursors ☐
Creating Protocols for - EP's ☐
BLINKS - Stimulating ☐
Saving Waveforms ☐
Cursors ☐
HRV ☐
Multi-Channel EMG/IOM ☐
Multi-Channel NCS ☐

Report Menu

While in an active patient file, press REPORT. The following functions should now be available:

View Report ☐
Edit Report (host directory) ☐
Interpretation ☐
Print Report ☐
Print Report and Waveforms ☐
Save Current Patient to USB ☐

Accessories

Main Contact (for ordering Consumable items):
Name: _____
Phone: _____

Please indicate style of Needle currently used:
Disposable Monopolar ☐
Disposable Concentric ☐
Disposable Injectible Monopolar ☐

Please indicate the length and gauge of the needles used: _____
Please indicate the number of EMG's performed monthly: _____

Please indicate if you are using:
☐ Disposable Electrodes
or ☐ Reusable Electrodes
for Nerve Conduction Studies

Please indicate your current Accessories Supplier: _____

Are you currently receiving Preferential Pricing for a Needle Contract? Yes ☐ No ☐

?? - Would you be interested in hearing how your studies, as well as save you time and money?

Accessories are able to enhance the quality of
Yes ☐ No ☐

XLTEK University

?? - Would you be interested in hearing how ***XLTEK*** *University is able to give you one-on one, on-site training, that can help you in the areas of, but not limited to:*
equipment use, basic and advanced clinical training, and insight on clinical correlation?

Yes ☐ No ☐

I am interested in:
- Nerve Conduction Studies/EMG ☐
- Evoked Potentials ☐
- Both ☐

COMMENTS

Please Confirm

Date Completed: _____

Client Name: _____ (please print)

Signature: _____

Sales Rep: _____ (please print)

Signature: _____

10. APPENDIX 2: TROUBLESHOOTING/MAINTENANCE

Here you will find information on how to work through trouble spots during the operation of the NeuroMax. If you cannot solve the problem, keep notes on the event so that you can explain them clearly to an XLTEK service technician.

If you continue to experience any difficulties in either the set-up or everyday use of your system, please contact XLTEK Technical Support:

Phone: 1-800-303-0306
Email: OTS@natus.com

10.1. SOFTWARE

The following sections show you how to verify the software version on your machine, how to update your software, and how to install NeuroMax Loader.

10.1.1. CHECKING SOFTWARE VERSION ON NEUROMAX

1. Turn on the power to the NeuroMax.
2. From the Main Menu screen, press **ESC** and the **V** key on the keyboard.
3. The version number appears in the bottom-left corner of the screen.

10.1.2. UPDATING SOFTWARE

Obtain the newest version of software by contacting Technical Support at 1-800-303-0306 or OTS@natus.com.

> **NOTE:** ANY CUSTOMIZATION OF TEST DEFAULTS AND REPORT FORMAT WILL NOT BE AFFECTED.

10.2. NERVE CONDUCTIONS

This section gives you the basic steps for creating a Nerve Conduction Study (NCS), how to edit it, and how to set up a stimulus site.

10.2.1. CREATING A NCS

1. From the Main Menu screen, select **Nerve Conduction Studies**.
2. Find a blank position and press **Backspace** and **C**. Edit new name and press **Select** to save. Now choose new nerve name, choose test, and choose side to go to acquisition screen.

10.2.2. EDITING AN NCS

1. From a NCS Acquisition Screen, press **Backspace** and **C** simultaneously (or press the gray **Default** key on the keyboard) to open the Test Defaults Editing screen.
2. In this screen you can customize the amplifiers, gains, filters, and timebase by using the Up/Down arrows to move through the list and the Left/Right arrows to toggle through the options.

10.2.3. SETTING UP STIMULUS AND RECORDING SITES

1. In the Test Defaults Editing screen, use the Down arrow to highlight **Reference Site** and press **R** to designate the reference site as **Recording** or press **S** for **Stimulation**.
2. Press the **Down** arrow to highlight Site 1. The Site Name List appears in the top-right of the screen.
3. Use the Right and Left arrows to select the site name you want and then press the **down Arrow** to continue.
4. Press the **Down** arrow to move down the next site and repeat step 3.

NOTE: IF THE SITE YOU NEED IS NOT IN THE SITE NAME LIST, GO TO THE MAIN MENU SCREEN AND SELECT **ADMINISTRATIVE OPTIONS**. SELECT **EDIT SITE NAME LIST**, FIND A BLANK POSITION, AND THEN ENTER THE REQUIRED SITE NAME.

5. To enter normal values, highlight **Normal Values** and toggle through latency, amplitude, CV and distance using the Down arrow and enter the normal values that you have established in your lab.

Once finished, press the **Select** key and then press **S** to save the changes.

10.3. ELECTROMYOGRAPHY

This section gives you the basic steps for creating an electromyography suite and how to use it.

10.3.1. CREATING AN EMG SUITE

1. Decide ahead of time the order of the muscles you want to have in the EMG Suite and make sure that they are in the EMG site name list.
2. From the Main Menu screen, select **Electromyography** and press the **Select** key.
3. From the Electromyography **Test Menu** select the Suite that you wish to rename and then press the **C** key.
4. Use the keyboard to enter the name of the Suite (e.g. upper limb) and then press the **Select** key to save the Suite name.
5. When the Suite Column appears, use the Select a**rrows** to highlight the first muscle in the list and then press the **Select** key to save highlighted name.
6. Move to the next muscle in the Suite to select and repeat.
7. Press the **Test Menu** key to save and exit Suite creation.

10.3.2. USING AN EMG SUITE

1. From the Main Menu screen, select **Electromyography** and press the **Select** key.
2. Select the Suite you want, the type of EMG test, and then the side.
3. The Suite name list appears in the active screen. Press the **Start/Stop** Control key to start recording from the highlighted muscle.
4. When you are ready to move to the next muscle, press the Test Menu key to highlight the next muscle or use the Up/Down arrows to move to the muscle you want to test. Once highlighted, press the **Start/Stop** Control key to begin recording.
5. When finished, press the Test Menu key to exit.

10.4. ADMINISTRATIVE FUNCTIONS

The administrative functions are designed to help you prepare the NeuroMax for your specific circumstances and to manage the data you have acquired once the testing is complete.

10.4.1. EDITING STUDIES

10.4.1.1. *EDITING A PATIENT STUDY WHILE IN ACTIVE PATIENT FILE*

1. From Main Menu screen, press the **Report** key.
2. In the Function column, choose **Edit Report**.

10.4.1.2. *EDITING A PATIENT STUDY NOT IN ACTIVE PATIENT FILE*

1. From Main Menu screen, select **Administrative Functions** and then select **Patient Directory**.
2. Using the Select arrows, choose **Patient Directory**, highlight patient name, and then select **Test Directory** in the Functions column.
3. Choose the test to edit and press the **Select** key, choose **Recall** and **Edit File**.

10.4.2. INTERPRETATION MACROS

10.4.2.1. *CREATING A MACRO*

1. From the Main Menu screen, select **Administrative Functions** and then select **Edit Report Format**.
2. From the Edit Report Format Menu, select **Edit Interpretation Macros** to view the 30 titles that can be edited. Each title represents one interpretation macro.
3. To edit a title, choose it using the Select arrows. A red cursor appears in the lower box. Next use the keyboard to enter your prepared macro into the highlighted position and then press the **Select** key to enter the macro.
4. When finished, press the **Select** key once to move onto the next macro.
5. To exit from the Edit Interpretation Macros screen, highlight **EXIT from Interpretation Macros** and press the **Select** key.

10.4.2.2. *USING A PRE-DEFINED MACRO IN A REPORT*

1. From the Main Menu screen, select **Administrative Functions** and then select **Patient Directory**.
2. Highlight the patient name and press the **Select** key.
3. Choose **Test Directory** from the Functions column and press the **Select** key.
4. From the Test Directory, highlight **Interpretation** and press the **Select** key to open the Interpretation window.
5. Type in your entry or enter a macro.
6. To enter a macro, press the **Notes** key and then the two-digit number that represents the title of the new macro to enter.
7. Press the **Select** key to exit from the Interpretation screen.

10.5. TROUBLESHOOTING

This section answers questions and gives you hints and pointers on how to deal with troublesome situations that may not require a service call.

10.5.1. SIGNAL CLIPPING IN NCS AND EMG

There are four possible courses of action.

i) Swap out recording cables.

ii) Try different channels.

iii) Check settings such as gain, filter, and notch filter settings.

iv) Return to Main Menu screen, select **Impedance Test**, and then check electrode impedance.

10.5.2. STIMULUS ARTIFACT

10.5.2.1. *WHAT IS A SHOCK ARTIFACT?*

The electrical stimulus pulse and surface electrodes give rise to an artifact consisting of an initial spike and a longer lasting tail which often interferes with the recorded signal. It has 4 sources:

i) Skin common-mode current escaping through the ground.

ii) High pass filter characteristics of the amplifier.

iii) Voltage gradient between the recording electrodes caused by a stimulus current flowing through the limb.

iv) Capacitance coupling between recording and stimulus leads.

The NeuroMax takes care of the first two variables. You can check the following:

i) Properly connect the patient to the NeuroMax.

ii) Provide a good ground close to the recording electrodes in order to reduce the common mode potential due to the stimulator.

iii) Reduce the skin to electrode impedances to reduce common mode voltages, artifacts and 50/60Hz interference.

iv) Avoid crossing stimulator and recording cables to eliminate induced currents.

v) Keep skin dry between electrodes to prevent bridging of the electrodes.

10.5.3. ELECTRODE IMPEDANCE

NOTE: It is important to keep electrode impedance low and balanced.

Electrode impedance should be kept below 10k (green range) for the best results in recording low amplitude signals (<50uV peak to peak). Higher impedance allows the incursion of power line interference (60Hz or 50Hz) and shock artifacts. Both of these phenomena can obscure your short latency sensory response. At these impedance levels, it becomes necessary to turn on your notch filter. Impedance greater than 100K red level with sensory responses below 100 uV peak to peak are invariably difficult to interpret.

Unbalanced electrode impedance will produce a specific shock artifact. If the Reference electrode (+) is larger than the Active electrode (-), the shock artifact will start from above the baseline and sweep down. Similarly, if reversed, the shock artifact will start from below the baseline and sweep upwards.

10.5.4. SKIN PREPARATION

NOTE: It is important to work with a clean skin surface.

The skin is a living tissue. As such it is made of various layers. The top three layers are of crucial importance as they are highly nonconductive. The three layers are the actual dermis, the dead covering of dry scaly dead skin, and a layer of oils, sebum, and dirt.

Normal SNAPs require no skin preparation. Clients who have callused, greasy, dirty, or dry skin require an extra effort on the part of the Physician/Technologist to obtain good results. Typically washing the skin area of interest (both recording and stimulus sites) with warm soapy water is adequate. For more difficult sites or where washing is difficult or inappropriate, rubbing with of an alcohol swab may be more efficacious. Remember, you are removing these three layers so use of gentle force may be required. We recommend the use of a mild abrasive such as Omni-Prep (pumice suspended in a mild detergent), the hard end of a Q-tip, or rough tissue paper for more difficult situations.

HAZARD WARNING: Rubbing the skin may expose you to blood borne diseases. It is your responsibility to protect yourself and the patient from any contact with blood borne diseases. Please take appropriate care.

10.5.5. ELECTRODE TYPE AND PLACEMENT

Proper electrode to skin connection is vital when attempting to perform a surface recording.

10.5.5.1. *GROUND ELECTRODE*

As a general rule, the larger the better. We recommend a stainless steel electrode with a surface area of at least 5cm^2 (0.75 inch^2). A few drops of a conductive paste should be applied to the skin and the ground plate pressed on top of this. It may be held in place with a piece of tape. Another common solution is the use of a large disposable self adhesive, pre-gelled electrode. Place the ground **BETWEEN** the stimulator and the recording electrodes.

10.5.5.2. *RECORDING ELECTRODES*

Please be consistent. Always use the same type of electrodes for active and reference, otherwise your results may not be consistent.

The most common type of electrodes are either metal discs (with conductive paste) or disposable self-adhesive electrodes. Both are usually about 0.5 to 3 cm^2 in area (0.1 to 0.5 inch^2).

The Active electrode (Black - Cathode) is to be placed over the nerve towards the cathode of the stimulator. The Reference electrode (Red + Anode) is placed 2 to 3cm (distance is set by your procedure) distal to the active electrode (relative to the cathode of the stimulator), again over the nerve. Make sure that the skin surface between all 3 electrodes is dry. In addition, stainless steel clip type electrodes with conductive paste may be used.
We do not recommend the use of steel coil electrodes for recordings if you are unfamiliar with their use. Slipping the coils onto the digit will disperse the gel between the two electrodes, usually causing an electrode bridge and subsequent shorting between the electrodes. Also, using spring coils or spring electrodes can increase the surface area and also disperse the signal since part of the surface area is over a silent area of the digit. Stimulus artifact may be reduced in these situations by covering the segment of the clip that is not over the nerve with a piece of gauze or tissue paper.

NOTE: YOU WILL ONLY PICK UP A SNAP IF YOUR RECORDING ELECTRODES ARE PLACED OVER THE CORRECT NERVE. BE AWARE OF ANOMALOUS INNERVATIONS.

10.5.6. STIMULATOR

Though the NeuroMax can stimulate well by simply pressing the stimulator prongs against the skin, if the message **Stimulator impedance high** appears on the screen you will be required to add a small drop of conducting gel to the stimulator prongs. Do not spread the gel otherwise the current will spread over a larger skin area, effectively diminishing the current under the prongs forcing you to increase the applied current and causing stimulus artifact problems.

10.5.6.1. *PATIENT COMFORT*

NOTE: A relaxed patient is your friend.

Keep the stimulus current to "just the right amount." Excessive current causes the patient to feel pain and the NeuroMax to pick up excessive stimulus artifact. Furthermore, tense patients contract their muscles and inject EMG activity into the sensory recording. This will make your NCV look very rough making correct interpretation impossible.

HINT: IF YOU SUSPECT THAT THE MUSCLE BENEATH YOUR ELECTRODES IS TENSE, TRY TO OBSERVE THIS WITH EITHER A FREE RUNNING SURFACE EMG OR BY INCREASING THE SPEAKER VOLUME. USE THIS TO HELP RELAX THE PATIENT.

10.5.6.2. *HOW TO STIMULATE*

NOTE: Slow and steady.

The amount of current is determined by slowly increasing the stimulus intensity until the SNAP appears. Continue to increase the current until the amplitude of the response ceases to increase. If the patient is obese, has hard, dry skin or has a neuropathy, then you will have to increase the current beyond normal limits. Remember, increasing the current will cause the current to spread and to be shunted in unpredictable ways almost always leading to the formation of a shock artifact.

10.5.6.3. *LEAD WIRES*

NOTE: Reduce induced currents.

With individual unshielded recording lead wires, the best results are achieved when the active and reference lead wires are of the same length and are loosely twisted together up to the point where they have to branch off to reach the electrode placements. They should be kept away from other cables and from the unit's enclosure to minimize interference from power lines and other external sources.

Similarly, when stimulating with two individual cables from the NeuroMax Stim Probe, those wires should also be twisted together and kept away from recording lead wires. This will ensure no increase in stimulus artifact due to coupling between cables.

In environments with high interference levels, better SNAPs are recorded if you use the NeuroMax shielded acquisition cable. This cable takes advantage of NeuroMax's unique active differential shield drivers producing efficient shielding without compromising on common mode rejection and signal bandwidth. This cable plugs into the 5 pin DIN connector on the headbox and provides alligator clips for active, reference and ground electrodes.

XLTEK's design differs from other manufacturer's shielded recording cables that do not support differential shield driving technology and instead rely on simply grounding their shields. Cables of this type add common mode capacitance to the input lines causing degradation of high frequency common mode rejection which in turn causes an increase in stimulus artifact and an increased susceptibility to high frequency interference. Depending upon cable length, signal bandwidth may also be compromised. Such cables may reduce power line interference at the expense of an increase in stimulus shock artifact, increased high frequency interference, and reduced bandwidth.

10.5.6.4. *WHEN ALL ELSE FAILS*

Sometimes the obvious solution is the right one. When all else fails, check the following:

1. Check your impedance. Keep both low and relatively even.

> HINT: IF BOTH ARE EXACTLY THE SAME, SUSPECT A FAULTY GROUND. UNPLUG THE GROUND, IMPEDANCES SHOULD RISE. IF THEY DO NOT, CHANGE THE GROUND CABLE.

2. Try running a surface EMG with the volume on. The EMG acts as an oscilloscope, if there is noise in the system, you may be able to spot it here.
3. **Unplug** any other devices on the same circuit such as **printers**, mechanical beds, vacuum cleaners, or other potential sources of leakage current.
4. A medical grade ground should be installed in your clinic. Some clinics do not have properly grounded electrical systems.
5. If the patient is tense, ask her to relax.
6. Frequent inspections of your cables will help prevent recording problems.
7. Always have a backup acquisition cable and a backup ground.
8. Are any of the electrodes touching? If so, they are causing a short circuit and you will develop an artifact.
9. Try pressing **X** on the keyboard to mathematically remove the shock artifact from the waveform in the acquisition screen.
10. Rotate the anode around the cathode. This might shunt the shock artifact away from the recording electrodes.
11. Increase or decrease the pulse duration of the stimulus.
12. Average the sensory response.

10.5.6.5. *REDUCING ELECTRODE IMPEDANCE*

1. Use an alcohol prep pad to swab the skin to remove any excess sweat or lotion.
2. Use a mild abrasive paste or pumice tape and gently rub the skin over the stimulation site to remove dead skin and then swab with the alcohol pad.
3. Instruct patients ahead of time to avoid applying lotion to the skin on the morning prior to their test.
4. Make sure that the sticky electrodes are adhering properly to the skin. If they have become loose, replace them with new ones.

5. Make sure that the Stim probe has some gel on the tips and that there is not gel all over the patient's skin causing a bridge.
6. Make sure that the patient is properly grounded--good sticky electrode, wet Velcro ground strap, and good connections in the headbox.
7. When in doubt, try another channel.

10.6. AV STIM

1. Attach the short cable between the NeuroMax and the AV Stim and then turn on the power to the NeuroMax. When the NeuroMax recognizes the AV Stim it will provide power to it.
2. When the power is turned on, the green power light on the AV Stim lights up and the red stimulus light flashes once confirming the initialization of the AV Stim with the NeuroMax.
3. The printer port of the AV Stim is not active with this version of the NeuroMax.

10.7. PRINTING

If you are having printing problems, try the following:

10.7.1. NEUROMAX

1. Shut down NeuroMax and printer and then disconnect all cables.
2. Reconnect all cables, turn on the printer, and then turn on NeuroMax.
3. From the **Main Menu** screen, select **Administrative Studies** and then select **Patient Directory**.
4. Select the patient file and then select **Print Report**.

10.7.2. PRINTER

- Follow the instructions from the printer manufacturer to print a test page.
- Does the printer need a new toner cartridge?
- Download files to USB mass-storage device and print through Microsoft Word or XLTEK Archiver on a PC.

10.8. RECOMMENDED USER PERFORMED MAINTENANCE

Following a regular schedule of general maintenance will help to prolong the lifespan of the NeuroMax. Regular maintenance performed by the user does not involve access to the interior of the NeuroMax; for service problems that require corrective maintenance and/or internal component service, please call the XLTEK Service department at 1-800-303-0306, or contact your local XLTEK representative.

Maintenance performed by the user involves regular inspection and cleaning of all system components, including the NeuroMax enclosure, keyboard, Screen, back panel and connectors, headbox and headbox cable, stimulus probe and cable, printer and printer cable and all electrodes and accessories.

Being an extremely portable system, the NeuroMax will probably be subject to increased daily wear and tear as compared to previous, larger EMG systems; this fact has been a very conscious part of the design of all aspects of the NeuroMax and its performance. That being said, taking basic care of the system by avoiding extreme physical contact will help prolong the lifespan of the NeuroMax.

CAUTION:
DISCONNECT THE POWER CORD FROM THE SYSTEM AND THE WALL BEFORE CLEANING. USE A LINT-FREE CLOTH. DO NOT USE ABRASIVE CLEANERS ON ANY SYSTEM COMPONENT(SEE NEUROMAX ENCLOSURE BELOW).

Be careful not to allow any excess fluid to seep into the internal electronic components of the system; be especially careful around the grills located both on the front panel near the top (i.e. the speaker grill) and on the left side of the NeuroMax near the back, as well as around the back panel connections and the headphone jack on the right side near the front.

10.8.1. NEUROMAX ENCLOSURE

The NeuroMax enclosure can be cleaned with a damp cloth, using water, mild detergent or cold sterilizing agent. As above, be careful to avoid allowing excess fluid to seep into any internal components. Since the enclosure is manufactured using a high-grade ABS resin, there should be no cracks in the case itself; periodic inspection of the enclosure mounting screws is only required to ensure that the screws are not coming loose.

10.8.2. KEYBOARD

The keyboard is made up of discrete keys and cannot be easily cleaned. If any material were to slip between the keys the NeuroMax can be held upside down to allow those pieces to drop. Also, individual keys can be cleaned carefully with Q-tips. Avoiding any sustained exposure to extreme temperatures (above 50^{o} Celsius or below -20^{o} Celsius) will help prolong the integrity of the keyboard.

10.8.3. SCREEN

The screen itself is protected with a front cover made from a mylar-type material, however the screen uses glass internally, so care should be exercised not to drop or bump the screen, as this may cause the glass to crack or break. The screen can be cleaned by wiping with a damp cloth with no water dripping off or a mild detergent; though a soft lint-free cloth is recommended for cleaning the screen.

10.8.4. BACK PANEL/CONNECTORS

The back panel of the NeuroMax contains the headbox connector, the printer connector, the AC power cord connector and the Power ON/OFF switch (and fuses). The panel itself is made of a heavy grade, reinforced fiberglass material; avoid any excessive physical stress on the panel itself or any of its components. Check regularly for any cracks that may have developed in the panel; contact XLTEK service if you suspect any physical damage to the back panel.

CAUTION:

DO NOT LEAVE ANY CABLES CONNECTED TO THE BACK PANEL WHEN TRANSPORTING THE NEUROMAX; DOING SO MAY CAUSE THE CONNECTORS TO COME LOOSE, AND/OR MALFUNCTION. THE BACK PANEL AND CONNECTORS SHOULD ONLY BE CLEANED WITH A DRY, SOFT, LINT-FREE CLOTH.

10.8.5. HEADBOX AND CABLE

The headbox should only be cleaned with a dry, soft, lint-free cloth. Check regularly to see if any of the electrode connections have become loose; if so, contact XLTEK service. The headbox itself is a completely passive electronic device, but care should still be taken to avoid extreme physical stress to the headbox. Check periodically to determine cable integrity.

DO NOT LEAVE THE HEADBOX ATTACHED TO THE NEUROMAX WHEN TRANSPORTING THE UNIT.

10.8.6. STIMULUS PROBE AND CABLE

The stimulus probe body and cable can be cleaned with a soft, lint-free cloth or a damp cloth soaked in water, mild detergent, or a cold sterilizing agent. Determine cable integrity regularly. The stimulus probe headpieces can be cleaned in the same fashion as the body, but extra care should be taken to remove all electrode gels or pastes that have been used on the headpieces; avoid any long term build-up of gels or pastes on the stimulus probe headpieces, as this may interfere with the optimal performance of the stimulus probe. If the various headpieces do not fit snugly into the probe body, replace them immediately to ensure optimal performance.

10.8.7. PRINTER AND CABLE

The NeuroMax must be used with an approved electronic device. The approvals should be IEC 950 or equivalent. It can also be IEC 601-1 + A1:1991 + A2: 1995\EN60601-1.03.96 approved. The printer is attached via a standard USB connector on the NeuroMax.

DO NOT LEAVE THE PRINTER ATTACHED TO THE NEUROMAX WHEN TRANSPORTING THE UNIT.

10.8.8. ELECTRODES AND ACCESSORIES

Regularly clean all surface electrodes and accessories with warm, soapy water or liquid sterilizing agents; ensure that all gels and/or pastes are removed from the electrodes and their cables. Follow the electrode manufacturers' instructions for cleaning and/or sterilizing all electrodes and accessories.

While the NeuroMax has been carefully designed and manufactured to be as reliable and durable as possible, regular cleaning and inspection of system components can only help the long term trouble-free operation of the system. As with other types of medical instrumentation, try to avoid extremes of physical stress (i.e. dropping the unit, etc...) and sustained exposure to extreme temperatures. If you suspect any problem that might impact on the safety or effectiveness of the NeuroMax, call XLTEK Technical Support at 1-800-303-0306, or your local XLTEK representative.

10.9. USER ADJUSTMENTS

If you experience any trouble operating the NeuroMax, it is possible that many of the problems may be overcome through simple user adjustments. This chapter offers a few suggestions designed to overcome some of the more commonly found difficulties; if you experience any trouble that is not described in this section, or if the suggestions here do not correct the difficulty you are having, please call XLTEK Technical Support or your local XLTEK Representative for service.

10.9.1. NO ELECTRICAL STIMULUS

The patient does not feel the stimulus pulse, or does not respond to any pulse as expected. The stimulus probe or stimulating electrodes connected to the probe do not deliver any electrical stimulus. Check the following:

1. Check the lower right corner of the screen, in the stimulator status area, to see that the "STIMULATOR ON" message is displayed. If the display reads "OFF", press the ***START/STOP*** switch once to activate the stimulator.

2. Check the stimulator status area to determine that the intensity level, in mA, is appropriately set for the current test.

3. Check the connection between the stimulator probe cable and the headbox to ensure that the fit is snug.

4. Check the connection between the headbox and the NeuroMax (at the back on the lower right side of the NeuroMax to ensure that the headbox is properly connected - be sure to tighten the thumbscrews so that the headbox cable does not come loose.

5. Check that the skin between the two stimulating electrodes (i.e. anode and cathode) is clean and free from any layer of conducting gel or paste that might create a bridge between the anode and cathode.

6. Press ***MAIN MENU*** to exit to the main menu, and then re-enter the current test to reset all software and hardware settings for the stimulus.

7. Check that the "Stimulator Impedance High" error message does not appear when you attempt to stimulate. If it does, clean the stimulus site on the skin and prepare the site with some type of abrasion (e.g. Omni-Prep) to decrease the impedance level.

10.9.2. NO RESPONSE FROM ELECTRODES

A. In NCS or EMG Mode - The acquired waveforms are flat, do not appear, or do not appear correct (or as expected). Check the following:

1. Make sure that the patient electrodes are connected to the correct amplifier channel in the headbox. In all test modes, the screen will display the currently active channel beside the test name in the data table area; check that the active channel corresponds to where the patient electrodes are connected in the headbox.

2. Check that the patient electrodes fit properly into the headbox (not loosely), and also check that there are no apparent breaks in the patient electrode cables.

3. Check the patient electrode impedance levels - if the impedance levels are too high, you may need to replace the electrode, electrode cable, or simply re-prep the recording site on the skin. Make sure that the positive and negative recording electrode sites have similar impedance values.

4. Check the connection between the headbox and the NeuroMax to make sure that it is tight.

5. Check the screen gain and timebase settings to ensure that they are appropriate for the current test. You may also want to check the LFF, HFF, and Notch Filter settings, as well as any sweep or trigger delays being used.

6. Press ***MAIN MENU*** to exit to the main menu, and then re-enter the current test to reset all software and hardware settings for the amplifiers

B. In Dual Channel Mode, check for all of the above situations, and then check the following:

1. If the current test calls for averaging, check that the "AVERAGER ON" message is displayed on the screen. If it is not shown, press the ***AVERAGER*** hardkey.

2. If the AVERAGER is "ON", check the raw data display to ensure that appropriate data is actually being acquired through the amplifiers (Press space bar to display raw data). If the raw data display is flat, then no data is being acquired by the amplifier(s).

10.9.3. LARGE STIMULUS ARTIFACT

There appears to be an excessively large stimulus artifact at the beginning of each triggered waveform; this can occur in any NCS or Dual Channel test, and may cover up the actual waveform of interest. Check the following:

1. Check the patient electrode impedance levels - if the impedance levels are too high, you may need to replace the electrode, electrode cable, or simply re-prep the recording site on the skin. Make sure that the positive and negative recording electrode sites have similar impedance values.

2. Check the integrity of the ground electrode cable. If it appears broken or bent at all, try replacing it.

3. Position the ground electrode between the stimulating electrode (or probe) and the active recording electrode.

4. If you are using a non-disposable, metal ground electrode plate, check that there is no corrosion or build up of gel on either the surface of the plate or the contact between the plate and the cable.

5. Check that the amplifier gain setting is appropriate for the current test. It is possible that you may be over-amplifying the signal being recorded, and thus over amplifying the stimulus artifact.

6. If you are using single shot stimulus mode, or even if you are using train mode with a low number of pulses per train, try using AVERAGED acquisition (i.e. press the ***AVERAGER*** hardkey to turn on the Averager) to reduce the influence of the variable "noise" of the Stimulus artifact.

10.9.4. NOISY DATA

The data being displayed on the screen seems excessively noisy. Check the following:

1. Make sure that the patient electrodes are connected to the correct amplifier channel in the headbox. In all test modes, the screen will display the currently active channel beside the test name in the data table area; check that the active channel corresponds to where the patient electrodes are connected in the headbox.

2. Check that the patient electrodes fit properly into the headbox (not loosely), and also check that there are no apparent breaks in the patient electrode cables.

3. Check the patient electrode impedance levels - if the impedance levels are too high, you may need to replace the electrode, electrode cable, or simply re-prep the recording site on the skin. Make sure that the positive and negative recording electrode sites have similar impedance values.

4. Check the connection between the headbox and the NeuroMax to make sure that it is tight.

5. If everything appears prepared and set up as it should be and there still appears to be noise in the data being acquired, try using the other acquisition channel. To switch acquisition channels, put the active and reference recording electrode cables (or the 5 pin D.I.N. cable) into the other channel designated on the headbox, and then press the ***CHANNEL SELECT*** button on the keypad to --- switch recording channels. The data area of the screen will always display which channel is currently being used.

10.9.5. UNIT DOES NOT POWER ON

The unit does not power on when the "on" switch is pressed. Check the following:

1. Check both ends of the AC power cord to ensure they are connected to the unit and the wall properly (use only an approved hospital grade, 3 pronged outlet for AC connection).

2. Check that the green LED for "power On" is lit up (this can be found below the screen on the left side of the front screen panel). If the power on LED appears to be lit and the screen is not on, call XLTEK service.

3. Check the fuse which is located beside the ON/OFF switch on the back panel. If the fuse needs replacing, replace only with two T3.15A/250 V fuse.

10.9.6. ERROR MESSAGES

Should any Windows error messages appear on your screen, they can always be removed by pressing either ENTER or ESC. Pressing ENTER will select the action highlighted. Pressing ESC will cause the action to be cancelled. We recommend that you always press ESC whenever a Windows error message comes to the screen.

There are also a few NeuroMax error messages which may appear from time to time when you are using the NeuroMax EMG system. Most of these messages have simply been designed to warn you that less-than-perfect testing conditions exist, or that you must do something to continue in a test mode. If any of these messages are unclear, please call your XLTEK representative. The following messages are presented in alphabetical order.

"Are you sure(Y/N)? If yes, current waveforms will be lost"

This message only appears when you have existing information in the patient information screen (i.e. the active or current patient file) and you select NEW PATIENT. When the system has been turned on and you are testing a patient (with patient info already entered), you may decide to press ***PATIENT INFO*** to enter the patient information screen. When you do this there are two choices shown - 1. Edit Current Patient, and 2. New Patient. If you SELECT the first option (Edit Current Patient), the cursor will move to the first patient information field and you can now edit existing information and/or make additions to the existing patient information screen. If you have finished testing the current patient and now have a new patient, this error message is simply warning you that the WAVEFORMS will be lost. It is important to know that you will not lose the existing patient file, the existing final report or the existing test files complete with all of the numeric data; only the actual waveforms will be lost. If required, you can exit the patient info screen, press ***REPORT*** and choose STORE REPORT WITH WAVEFORMS. However, if you simply select new patient, the complete patient file, minus only the actual waveforms, is automatically stored.

"Erase Trace(s) to Acquire more data"

The NeuroMax can acquire up to eight traces per dual channel test screen, and up to twenty stored traces for all F-wave and H-reflex tests. Once you have acquired a complete set of data for any one of these tests (i.e. all trace locations have waveforms), you cannot acquire any more data for the current test. If you try to acquire more data in this instance, the screen will display the error message shown above. There are two ways to acquire more data in this case:

1. You may choose to erase a particular trace or set of traces

-OR-

2. Press ***TEST MENU***, and re-select the current test to acquire a new set of data while automatically storing the old set of data.

Once again this error message appears simply to let you know that you must proceed in a particular fashion, so that no test data is ever inadvertently erased.

"WARNING: the flash memory is almost full"

The permanent storage capacity of the NeuroMax is almost full. There will not be enough memory available to store all data and waveforms for the current patient if the test is too large. To proceed with the current test, you must first make additional memory available by deleting some patient final reports from the patient directory, remembering that reports stored with waveforms require substantially more memory than reports only.

"Previous data will be erased. To accept, press Y. Any other key to keep present data and not start stimulator."

You are in the RECORD mode of the F wave test modality. You have already acquired a set of F wave responses which are displayed on screen, with the associated data values in the data table. When you press the ***START/STOP*** switch to begin another train of stimuli or deliver a single shot stimulus, this error message appears. If the existing data set on screen is inadequate and you wish to erase them and acquire a new set, press Y and then ***START/STOP*** to erase the existing trace set and acquire a new set. If you wish to keep the existing set and acquire a second set for comparison later on, press N, and then press ***TEST MENU*** to re-select the F wave study and acquire a new set of responses. By going through the ***TEST MENU***, you are in essence doing a "new" test, and once completed the patient file will have both F wave tests, with their associated test times, in storage. In this manner, you can do a couple of tests, and then at some later time edit or delete one of the tests, keeping the other one for your final report.

"Printer Error"

This message only appears when you attempt to either print a screen copy or a final report. The printer is either not connected to the NeuroMax, or it is not powered on. When the NeuroMax is initially powered on, AC power is immediately supplied to the printer; however, if for some reason the printer is turned off during testing, you must press the printer's POWER ON button to re-initialize the printer.

"Printer Out Of Paper"

This message only appears when you attempt to either print a screen copy or a final report. The printer is simply out of paper, and you must feed either a single sheet into the drive mechanism or load the sheet feeder with more paper.

"Out of Range"

You have either entered an invalid number for the number of pulses in the train or You have entered an invalid number for the stimulus frequency. The maximum number of pulses allowed in any single train is 60 pulses; the minimum number is 2 pulses. Therefore the number of pulses that can be entered is between 2 and 60 pulses. The stimulus frequency range is nominally 0.0 Hz to 50.0 Hz; the number entered must be lower than 50.0. You may choose any value below 50.0, accurate to one decimal place (i.e. 27.8 Hz is acceptable).
For patient safety and comfort however, the maximum stimulus frequency is also dependent upon the pulse duration chosen, such that at higher stimulus pulse durations, the maximum frequency available is decreased (see Table 9.1 below).
Table 9.1 - Maximum Stimulus Frequencies at all Pulse Durations

Pulse Duration	Max. Stim Frequency
0.05 ms	50.0 Hz
0.10 ms	50.0 Hz
0.20 ms	25.0 Hz
0.30 ms	16.6 Hz
0.50 ms	10.0 Hz
1.00 ms	5.0 Hz

"Stimulus Impedance High"

The NeuroMax has been designed to deliver a constant current stimulus pulse throughout a wide range of skin impedances; the current will be constant as long as the impedance is below 4,000 Ohms. Above this level, the actual current being delivered to the patient may be less than the pre-determined value chosen by you. To warn you of this situation, whenever you try to deliver a stimulus pulse and the impedance level is over 4.0 kOhms, the system will deliver the pulse and display the error message superimposed above the trace that was acquired. The best course of action is to improve the skin preparation of the site used for stimulating. Alternately, you may wish to check the integrity of any electrode or electrode cable you are using to deliver the stimulus pulse to the patient.

"This test is not yet defined for the selected nerve"

You are in the Nerve Conduction Studies ***TEST MENU***, and have already selected a nerve to test. The selected nerve appears in the menu as a highlighted selection. For a particular nerve, only certain tests have been defined, and you currently have highlighted a test which is NOT defined. If you continue on by pressing the ***SELECT*** switch, the default NCS test screen will

appear. Press the left or right arrows of the SELECTOR SWITCH and see that as you highlight different tests for the selected nerve, the error message will appear and disappear, depending on which test is highlighted. As an example, if you choose RADIAL nerve and then highlight "H Reflex", the error message appears, because no H reflex test has been defined for the radial nerve. If you now press the left arrow three times to move to SNC, this test has been defined, so the error message will disappear.

"To move to the RECORD screen, at least one M wave must be obtained."

You are currently in the SET UP mode of either the F wave or Repetitive Stimulation test, and you have pressed the ***SELECT*** switch to move to the RECORD mode. In the SET UP mode of these two tests, the first step is to acquire an appropriate M wave response before proceeding to the RECORD mode. The system requires that you have at least one M wave on screen before moving to the RECORD mode. Press the ***START/STOP*** switch to acquire an M wave response before pressing ***SELECT*** to move to the RECORD mode.

10.10. CHECKING CALIBRATION OF NEUROMAX

The factory calibration is digitally stored on the unit and should NOT be modified outside the factory. External checking of the calibration may be performed. The accuracy of the stimulator is better than 1% in both amplitude and duration. The accuracy of the waveform acquisition section is also better than 1% in both amplitude and time.

A calibrated oscilloscope and a calibrated signal generator are required to calibrate the unit. Attach the Headbox to the NeuroMax; insert the stimulator into the headbox and proceed with the calibration.

10.10.1. CHECKING THE STIMULATOR CALIBRATION:

1. Place a 1Kohm 1% resistor across the leads of the stimulator
2. Access a test routine and temporarily reset its parameters. As an example: SELECT Nerve Conduction Studies ➔ Next SELECT Median ➔ Next SELECT a Test MNC ➔ Select any side and press SELECT to enter the Test Screen
3. Once in the Blue Test Screen, press STIMULATOR. Set the stimulator to 1.0msec pulse duration, and 100mA Max Intensity. Press STIMULATOR to exit
4. Increase current to 100mA by pressing the STIMULUS UP arrow key

5. Measure the voltage generated across the resistor using a calibrated oscilloscope.

   Results: The voltage should be 100 +/- 1 Volt, duration should be 1 +/- 0.01 msec.

10.10.2. CHECKING THE WAVEFORM

1. Put a 80mV peak to peak 1KHz waveform into Channel 1 using a calibrated signal generator
2. From within the Blue Test Screen, press SETTINGS
3. Change the display settings to Notch Filter OFF LFF 0.1 Hz HFF 15 kHz Gain 10mV/div Timebase 5msec/div
4. Repeat with other Channel(s) Note: In Dual Channel, a 80mV signal may be too large to display on the screen. Be certain that the display is set at 20mV peak to peak

   Results: The amplitude of this waveform should be 80mV peak to peak +/- 0.8m

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A Total Service Solution

Standing behind every XLTEK product is Natus Medical Incorporated, an internationally respected innovator of medical products and services.

Our Neurology systems are backed up by an in-house support team staffed with technical and clinical experts, 24/7 support, remote support via WebEx or VPN, the largest clinical and technical field support network in Neuro/Sleep and customized service contracts that include preventative maintenance visits and computer upgrades.

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